GENERAL LIBRARY
FEB 24 1919
Engineering Library

Engineering News-Record

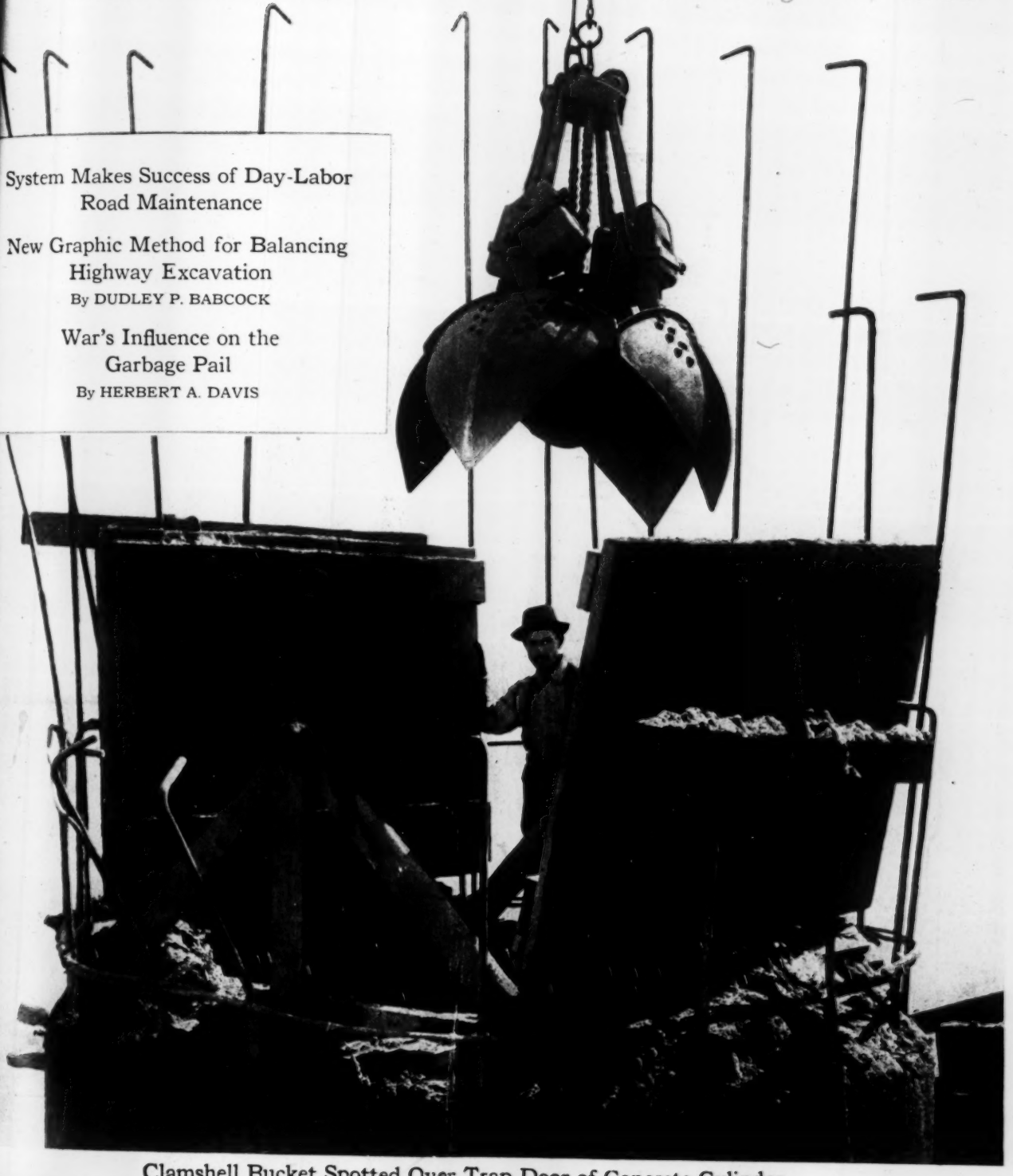
Devoted to Civil Engineering and Contracting
McGRAW-HILL COMPANY, INC.

February 20, 1919

System Makes Success of Day-Labor Road Maintenance

New Graphic Method for Balancing Highway Excavation
By DUDLEY P. BABCOCK

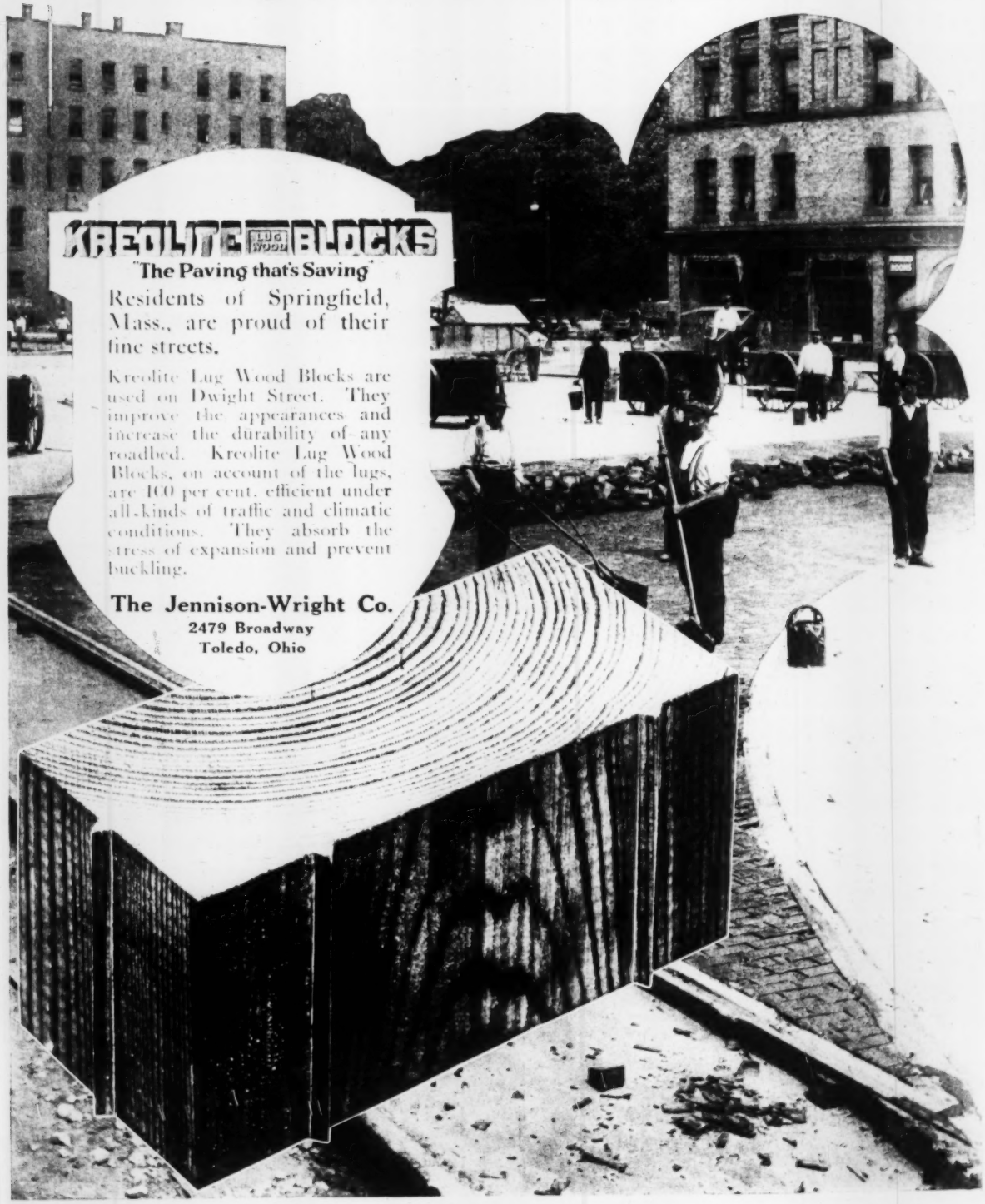
War's Influence on the Garbage Pail
By HERBERT A. DAVIS



Clamshell Bucket Spotted Over Trap Door of Concrete Cylinder

KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"



KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"

Residents of Springfield, Mass., are proud of their fine streets.

Kreolite Lug Wood Blocks are used on Dwight Street. They improve the appearances and increase the durability of any roadbed. Kreolite Lug Wood Blocks, on account of the lugs, are 100 per cent. efficient under all kinds of traffic and climatic conditions. They absorb the stress of expansion and prevent buckling.

The Jennison-Wright Co.
2479 Broadway
Toledo, Ohio

Volume 82 February 20, 1919 Number 8

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR.

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

Economic Balancing of Highway Excavation by a Semi-Graphic Method 361

By Dudley P. Babcock.

Device called the "trace curve," used in designing the Storm King highway of the New York State Highway Department, is particularly useful to supervising engineers in checking earth distribution.

Engineering News-Record, Feb. 20, 1919. 7¼ cols. Ill.

Thoughts on the Engineer's Relation to the Community 364

Engineering News-Record, Feb. 20, 1919. 2¾ cols.

Concrete Material for Army Base Hauled by Motor Trucks 366

Special Equipment utilized at South Brooklyn supply unit for stevedoring and haulage—Truck performance and cost of delivery analyzed.

Engineering News-Record, Feb. 20, 1919 5¼ cols. Ill.

University Dean Urges Better Conditions for Railway Engineers 368

Engineering News-Record, Feb. 20, 1919. ¾ col.

Material Prices Halt Chicago Building Operations 369

Costs $1,873,239 Today to erect a building costing $1,000,000 in 1915—Wage increase only partial cause.

Engineering News-Record, Feb. 20, 1919. 2¼ cols.

New York Barge Canal's First Operating Season 370

One Federal and two state officials report independently on canal operations under Federal control, and give reasons why it carried less freight last season than ever before.

Engineering News-Record, Feb. 20, 1919. 6 cols.

War's Influence on the Garbage Pail 373

By F. C. Eamman.

Engineering News-Record, Feb. 20, 1919. 10⅛ cols. Ill.

Shallow Brick Stand Up Well on Cement-Sand Base 378

Patching Brick on ramps of Pennsylvania Station, New York, shows them to be worn nearly through without breaking.

Engineering News-Record, Feb. 20, 1919. 3 cols. Ill.

What and Where to Buy 176

Omaha Track-Elevation Bridges Vary in Type to Meet Local Conditions 380

City Requirements and topography influence designs—Steel and concrete spans used, some with temporary floors—Precast-concrete drains on ballasted decks—Steel girders have concrete facing.

Engineering News-Record, Feb. 20, 1919. 5 cols. Ill.

Removing Algæ from a California Irrigation Canal 382

By E. Court Eaton.

Fixed Screens and copper sulphate inadequate—Rotary screen with water jet and heavier dose of agent used.

Engineering News-Record, Feb. 20, 1919. 2 cols. Ill.

Transmission Line With 4801-Ft. Span Over St. Lawrence 383

Longest Transmission cable span in world on tower 350 feet high takes place of former submarine crossing.

Engineering News-Record, Feb. 20, 1919. 2 cols. Ill.

System Without Red Tape Makes Success of Day-Labor Road Maintenance 384

Ohio Highway Department selects superintendents for ability to accomplish results—Employs flexible organization of foremen and patrolmen—Weekly report forms show exact status of each job.

Engineering News-Record, Feb. 20, 1919. 5 cols. Ill.

Editorials 357

Engineering Literature 387

Letters to the Editor 393

Hints for the Contractor 396

News of the Week 398

Construction News 76

Index to Advertisers 184

Searchlight Section 65-97

McGRAW-HILL COMPANY, INC., 10th Avenue at 36th Street, NEW YORK

JAMES H. McGRAW, President
ARTHUR J. BALDWIN, Vice President
E. J. MEHREN, Vice President
EDWARD CALDWELL, Treasurer
JAMES H. McGRAW, JR., Secretary

WASHINGTON, D. C., 610-611 Colorado Building
CHICAGO, Old Colony Building
PHILADELPHIA, Real Estate Trust Building
CLEVELAND, Leader-News Building
SALT LAKE CITY, 519 Newhouse Building
SAN FRANCISCO, Rialto Building
LONDON, E. C., 6 Bouverie St.

Cable Address: "Machinist, N. Y."

Publishers also of
Electrical World
American Machinist
Power
Engineering and Mining Journal
Electrical Merchandising
Coal Age
Chemical and Metallurgical Engineering
Electric Railway Journal

United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines, $5 per year; Canada, $7; elsewhere, $9. Single copy, 20c.

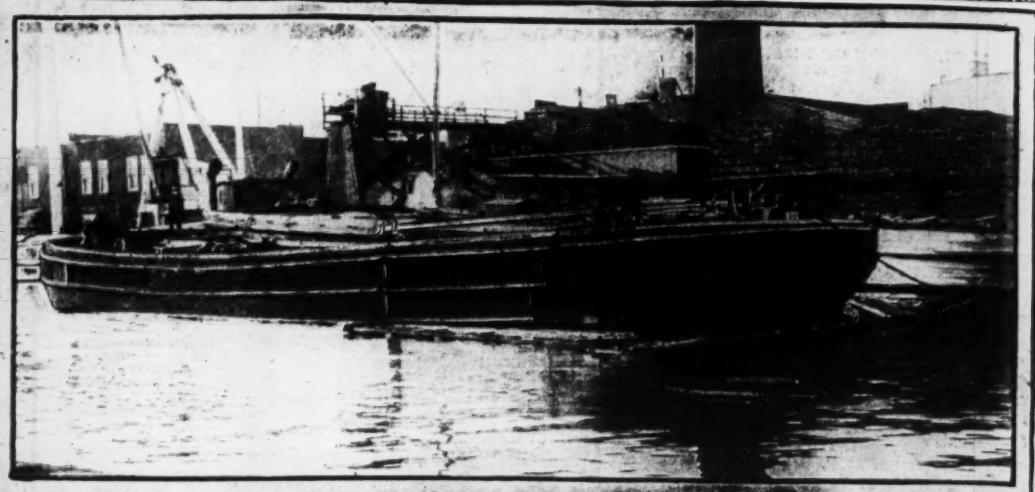
No back volumes for more than one year and no back copies for more than three months.

Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at least ten days before the change takes place.

Published Weekly. Entered as second-class matter Apr. 11, 1917, at the Post Office at New York, under the act of Mar. 3, 1879.

Member Audit Bureau of Circulations. Member Associated Business Papers, Inc.

CIRCULATION OF THIS ISSUE 33,000 COPIES



Reinforced-Concrete Tanker, Standard Oil Co., New York. Built by Fougner Concrete Shipbuilding Co., Inc.

IN accordance with the ruling of the War Industries Board at Washington, this Company is now at liberty to offer to the trade without restrictions

Havemeyer Bar Service

We can therefore offer you immediate delivery of Havemeyer Bars from our nearest warehouse for use on buildings, concrete ships, or other types of construction.

HAVEMEYER PRODUCTS

include labor-saving devices which can be used effectively in economizing and saving money.

Write us for further information

CONCRETE STEEL COMPANY

42 Broadway, New York

Boston Philadelphia Birmingham Chicago Cleveland Syracuse Washington

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, Editor — Charles Whiting Baker, Consulting Editor

Volume 82 — NEW YORK, THURSDAY, FEBRUARY 20, 1919 — Number 8

Psychological Test for College Entrance

ONE definite effect of war experience on education is seen in the recent announcement that Columbia College will abandon the old system of entrance requirements and in September substitute psychological tests. These tests are patterned after those used in connection with the admission to the Students' Army Training Corps, but will be designed definitely to test the applicant's fitness for continuing academic work. As Dean Hawkes aptly expresses it, "We expect these tests to show us whether it will be worth our while to try to educate the student, and whether it will be worth his while to have us try." One of the best results of the new experiment, it may confidently be predicted, will be the more intelligent selection of students—for the system must by its very nature introduce more of the element of judicious choice, which is to be based not alone on the new psychological test, but also upon the high-school and general previous record of the student. In this way, the highly reprehensible practice of accepting men who cram up a few weeks before college entrance examinations, and then disgorge upon examination day, will be effectually abolished. It is to be expected that engineering colleges all over the country will follow in the adoption of tests of the new type, in order to determine those qualities of general intelligence and maturity of mind which in the last analysis make a given student's career in college valuable, both to himself and for the future of his profession.

Monolithic Brick Pavements Justified

CONCLUSIONS drawn from the investigation of the construction of the ramps of the Pennsylvania Station in New York City favor the use of rigid brick construction. Considerable interest centers around these ramps, the replacement of small sections of which is described on p. 378. This is due to the fact that they were among the earliest instances of rigid construction and also because they were a bone of contention between those who held to the old theory that vitrified brick must be laid upon a sand cushion, and those who favored the rigid system of construction known as the monolithic. The excellent service which these ramp surfaces have given is all the more striking because the brick were only slightly more than half the standard depth for paving block, which is 4 in. Furthermore, they had worn more than halfway through and were still in an unshattered condition, which certainly discredits the theory that impact has a pulverizing effect upon rigid brick surfaces, and supports the contention of those who advocate the use of much thinner brick in monolithic and semi-monolithic construction. In the reconstruction it has been necessary to use a deeper cement-sand bed than is usually recommended, to bring the pavement up to the new street grade. This would have been dangerous on the old sand-cushion type of construction, and the action of these surfaces with mortar bed will be watched with interest.

Work of National Society Secretaries

PROTEST has been made against a letter signed "M. Am. Soc. C. E.," printed in *Engineering News-Record* of Jan. 23, 1919, p. 201, wherein the author criticises the secretaries of our national engineering societies and foundations, declaring, among other things, that their sole occupation is to write useless reports and letters, and that they get two to three months' vacation a year. The sweeping scope of the criticisms is their own condemnation. Manifestly, it is absurd to characterize the work of the societies as useless, even though one does not agree with policies, while the statement that the secretaries get from two to three months' vacation each year does not accord with the facts. The thoughtful reader, conversant with the work of the societies, will realize that the concluding paragraph of the letter was perhaps written in a Pickwickian sense. We regret that, through an error in the editorial office, the offending paragraph was left in the letter.

Public Works or Public Charity

SINCE the signing of the armistice this journal has persistently urged the quick resumption of public works on a large scale, holding that it was the duty of the community to "take up the slack." In fact, even while the war was in progress, we persistently urged the planning of public works, holding construction in abeyance until hostilities should cease. Since the armistice came, the public-works propaganda has received considerable impetus. Much literature has been produced, but nowhere have we seen the case of public works versus public charity presented so clearly as in a pamphlet by Prof. Harold G. Moulton, of the University of Chicago, published by the Union League Club of Chicago. He puts the case in his conclusion in these expressive words:

"We know as a matter of course that we cannot permit either our returning soldiers or war workers to starve; we know that the least we can do, if jobs

are not available for all, is to open our charitable purses and extend them such indirect alms as we may. We have the choice, therefore, of two methods of meeting the situation: (1) By providing employment on public works of enduring value; (2) by supporting by public charity an army of unemployed in nonproductive idleness. The former is the way that will make for satisfied, self-reliant American citizenship; the latter is but a palliative—it prevents starvation, but it does not avoid ingratitude and bitterness of spirit, nor make for orderly social and economic life. The former is the socially efficient way, the way that conserves human resources and increases the productive capacity of the nation; the latter is the socially wasteful and inefficient way—that makes for the degradation of the individual and the depletion of national productive power.

"The latter is the way of the old era of ill adjusted and unregulated industrial life; the former is the way of a new era of economic and social efficiency. Which way shall we make the AMERICAN way?"

Universities Should Act to Help the Engineering Profession

THE protest of Dean Richards, of the University of Illinois, against the low pay of engineers in railway service, printed on p. 368 of this issue, is a protest from the right source. Such protests ought to be forwarded from dozens of the universities. There has been in the past a regrettable tendency on the part of engineering school authorities to close their eyes to the evidence that all was not well with the engineering profession. There has been ample publicity of statements from the engineering schools as to the great need for engineers and the great future of the engineering profession as a factor in the world's activities; but how seldom has there been outspoken public utterance to impress upon the public its great loss from failure to appreciate properly and reward properly the engineer's service!

The heads of our engineering schools are but human, and it has been quite natural for them to force into the limelight those of their graduates who have achieved phenomenal business success and quietly ignore the men, in many cases of equal ability, who, through force of circumstances, and—to put it frankly—the oversupply of engineers in particular fields, have been forced to continue in routine work at meager compensation. The heads of our great engineering schools and universities, however, have a large influence on public opinion. Such protests as that which Dr. Richards has so well voiced might well be heard from every school in the United States which teaches railway engineering. Such protests are called for not merely in justice to their own graduates and to the men they are preparing for service, but on the ground of public welfare. No one doubts the truth of Mr. McAdoo's recent declaration that national prosperity depends upon the efficiency of the country's transportation system. That efficiency is largely determined by the quality of the men placed in charge of the railways and their expert knowledge of the business. Unless railway engineers can receive adequate compensation, the engineering schools may as well abandon their courses in railway engineering.

Improving the Efficiency of Ship Fabrication

SHIPBUILDERS have been very slow to accept the idea of ship fabrication. Many of them are indifferent to the subject, some even to the degree of denying it a hearing in their own thoughts. With the completion of the two great inland fabricating shops built at the initiative of the Emergency Fleet Corporation, the fabricated-ship system takes on a new aspect. The layout of these shops, described in our issue of Feb. 13, 1919, p. 332, was not hampered by any external conditions, and had the benefit of thorough experience in all classes of steel fabrication. Shipyard shops lack similar advantages, and their comparative working results are likely to reflect this fact. They will find these new shops redoubtable competitors.

A recent English word on the prospective future of fabricated ship construction compels attention. Describing the "N" or national fabricated steel ships being built in England, *Engineering* of Jan. 17, 1919, said:

"The fabricated ship is a vessel of almost mathematical precision, which may in subsequent years set a distinct shipbuilding precedent, even among private owners. . . . No estimate of the cost of a fabricated vessel is available, but whether it be higher or lower than the cost of a vessel built in the ordinary way is no comparative criterion of value. Organization and facility of resource are the only weapons with which to combat the abnormal costs due to the war, and in consequence with the lapse of time the fabricated vessel is bound to prove a cheaper vessel than what might be termed a 'single-effort' ship."

For a year past, experiences in America have pointed substantially to this conclusion, available to all concerned with the shipbuilding industry; yet many yard men may regard the above expressed views as a weighty confirmation of what we ourselves had learned.

With shops now available for shipwork that are larger and more skilfully laid out than any shipyard shops, and, furthermore, are free from all the local limitations of the yard, the question of economy in the steel-fabrication part of shipbuilding will depend solely on the organizational skill with which the relations between shop and yard are handled. Given a satisfactory solution of this problem of organization, it may be said at once that on the score of economy the outside-fabrication system of shipbuilding will succeed in holding its own, since design and templet processes and the task of erection are easily adjusted to the system.

However, any new system, in order to become a working success, must be handled with sympathy and even a certain degree of enthusiasm. It is hardly open to doubt that the concerted hostility of all shipyard men would kill off the fabrication system temporarily, in spite of the most convincing demonstration of superiority. On the other hand, since the support and cultivation of any system tending to promote economy and efficiency is greatly in the national interest, it is to be hoped that the operation of the new shops will be directed with unusually careful attention to efficiency and schedule sequence, and that the facts as to results obtained may be made public as soon as possible. By this course the real possibilities of outside fabrication should be fully developed, and their application for the benefit of our shipbuilding industry made certain.

Garbage During the War and After

THE war wrought sweeping and, it may be, lasting changes in garbage disposal. It lessened the volume and grease content of garbage and led many cities to utilize vast quantities of fats and fertilizer base which had been going to the dumps or the furnaces. It is hardly to be expected that the household economies which resulted in decreased volume and richness of garbage will be fully maintained now that the war-saving spur is over, but in the interests of family, community and national thrift it is to be hoped that not all this gain will be lost. Certainly, for some years to come engineers, contractors and municipal officials having to do with garbage disposal cannot safely ignore these reductions in the quantity and richness of municipal garbage

How extensive have been the changes from nonutilization to utilization methods, the great further possibilities in this respect, and the main trends in garbage collection yields during the past two years, are shown by data and analysis in a contribution by F. C. Bamman, based on United States Food Administration investigations, which appears elsewhere in this issue.

The outstanding fact in the article is that during the year 1918 alone, 40 cities changed from dumping or burning their garbage to feeding it to hogs. That only three cities changed to reduction was chiefly due to war inhibitions on using capital, labor and materials for building reduction works. But now that the possibilities of hog feeding, with its relatively small plant and capital equipment, and the speed with which it can be got into use, have been shown, further rapid extension of this method of disposal may be expected.

Experience shows that garbage feeding is practicable for large cities. Some of the cities that changed from waste to feeding in 1918 have populations of more than 100,000. Moreover, already in 1919 Baltimore has let a five-year contract under which the garbage of that large city will be fed to hogs, as set forth at length in *Engineering News-Record* of Feb. 6, 1919, p. 287, and St. Louis has made terms for disposal by feeding while drafting specifications on which to invite bids for a longer contract. It should be noted that this change at St. Louis means the closing of a garbage-reduction plant.

Demands for glycerine and fats during the war stimulated garbage reduction wherever plants for that purpose were available. A world shortage of fats still exists, but recently the price of grease has fallen heavily, apparently due to after-war conditions which it is hoped will be but temporary. There is still need for fertilizer tankage which, like grease, is a product of garbage reduction. It is to be expected that ultimately both grease and tankage will sell at considerably less than war prices. This must be taken into account in projecting new garbage-reduction plants, as must also the present high prices of material and labor entering into their construction.

Until the various uncertainties now attending garbage reduction are removed by time and experience, conservatism in entering on new projects will be the part of wisdom. This does not mean that a pound of garbage need be wasted. Hog feeding is a ready means of utilization which should receive consideration wherever reduction—in existing or new plants—is for the time being impossible or of doubtful expediency.

The municipal field for garbage utilization by either reduction or feeding is still large. Mr. Bamman's conclusion is that the garbage now wasted would yield 30,000,000 lb. of grease and 60,000 tons of fertilizer tankage, with a remainder sufficient to produce 40,000,000 lb. of pork yearly. The world needs this grease, fertilizer and pork. Our cities, engineers and contractors should join hands for their production.

At such a juncture those unfamiliar with political and other local conditions in New York may well be surprised to hear that the garbage of some 5,000,000 people is to be dumped at sea temporarily while plans are being made and effected to burn it in refuse destructors scattered over the city. No evidence has been brought forward to show that the reported decision to destroy vast potential quantities of grease and fertilizer is based on careful engineering studies. The subject is one to which the engineers and engineering societies of Greater New York might well direct immediate attention.

A Federal Department of Public Works

IN TWO committee bearings recently members of Congress have discussed with witnesses proposals to establish a Federal Department of Public Works. One of the proposals was, it is true, for an emergency board, but the principle of a single engineering construction organization for the National Government was involved.

To the surprise of the civilians who appeared before the committees, the attitude of the senators was a sympathetic one. The war lesson as to the value of coöperation has had a telling effect, and the absurdity of scattering the Government's engineering and construction work through five administrative departments stands out stronger now than in the days of antagonistic individualism. A government which demanded of each industry that it mobilize in a single trade association or war-service committee does not find it so difficult now to see prospective benefits from combining under one head all its own functions of a similar character.

We do not believe that there is a member of Congress who would undertake to defend the placing at one time of public-building work under the Treasury, river and harbor work under the War Department, the Geological Survey under the Interior, and the Coast and Geodetic Survey under the Department of Commerce. No logic can defend the existing situation. Administrative exigencies or influences, which long since have disappeared, made for a now indefensible distribution.

But that which exists, no matter how absurd and illogical it may be, will always have defenders. Consequently, it will be necessary for those—the engineers of the country—who realize the absurdity of the present scattered scheme, to press home repeatedly and with emphasis the advantages of coördinating all of the Government's construction and engineering work. What are the advantages?

Under centralization, there would be elimination of duplication, especially in supervising the widely scattered work of the Government. There would be standardization of specifications and of materials. The large scope and volume of work would permit of the employ-

ment of a goodly number of broad-gaged engineers at the top, whose experience and counsel would make for the broader planning and execution of work. In private engineering enterprises it has been demonstrated that a high-salaried engineering organization is a *sine qua non* of economy. Then, too, come all the advantages of close alliance between men engaged in the same class of enterprise—the interchange of thought between experts—while the size of the organization would permit of a degree of functionalization not possible when the same amount of work is split up among ten or more bureaus.

These are obvious advantages; advantages such as are reaped in any consolidation, whether in industry or in government bodies; advantages that have been aimed at in several states in consolidating their engineering and construction bureaus into a state department of public works.

But there is another advantage which in the National Government weighs heavily for a Department of Public Works. It so happens that the great Congressional pork barrels are the rivers and harbors and the public buildings bills. These have become public scandals because no great administrative department in the President's cabinet was in a position to lay out a defensible scheme of public improvements that the President could back as a policy and on which he could solicit the support of the country. The execution of rivers and harbors work has been a side issue with the War Department, and its immediate execution placed in the hands of men whose habit is to obey without question, whose initiative is discouraged by the Army system, and who lack the business experience and point of view to assume responsibility for an economic program. Consequently, though executed under a body of notably highminded men, our river and harbor work has been—counting returns for our expenditure—one of the shames of the nation. A Secretary of Public Works and Engineering in the President's cabinet could secure for a sound policy that Presidential support which on occasion, by threatened veto, has forced river and harbor bills into some semblance of decency. Moreover, a sane policy would be a refuge for many a Congressman now forced into the pork scramble by real or assumed pressure from constituents and by the contagious example of his fellow legislators.

Were the ten or more engineering and construction activities of the Government thrown into one department, the aggregate expenditure, on the pre-war (1916-17) basis, would be nearly $100,000,000. This would be no mean department, for, on the basis of amount of appropriation, it would be exceeded only by the War and the Navy departments.

Reforms of this sort do not come easily. They do not come through the silent wishes of thinking citizens, nor even through the resolutions of engineering or other bodies. They come through the education of the people's Congressional representatives by the people themselves.

If you believe that there should be a national Department of Public Works, if your engineering society believes it, there is but one useful course of action—to tell it to your Senators and Representatives. And, in the telling, it might be wise to soften your strong views on the iniquity of pork-barrel methods.

How Not to Start a Canal Going

OFFICIAL explanations of last year's low traffic on the completed New York canal system, as abstracted on another page, do not increase public confidence in the Federal control of the system. Operating a modern canal is a new business in this country. Neither navigators nor shippers are used to it; the one is not at all persuaded either of its economy or its effectiveness, the other does not sufficiently realize that old mule-boat methods mean the added time and expense which defeat the purpose of the waterway. They both, in the advertising man's parlance, have to be "sold" on the canal "proposition." The State of New York has $155,000,000—much more if the old canal is capitalized—tied up in the Barge Canal, and it cannot get a fair return on this investment unless the canal is used. To get it used is the main duty of those who control it. Here is where the Railroad Administration failed.

The Federal authorities took the canal over as a going part of a successful transportation business—that is, the railroads adjacent to the canal—and expected it to show like returns on the investment. It did little to encourage canal traffic except to provide boats, which, contrary to prediction, were available far in excess of the freight offered. It permitted an erroneous impression of Federal monopoly of operation to remain abroad many months. Finally, it insisted on freight rates which paid a profit according to its own system of bookkeeping, the bookkeeping of a going concern. "Here is the canal; use it or leave it," was, in effect, its attitude.

No waterway today can be started on any such basis. The economy of canal transportation is at best debatable, and it will not be settled in this country until a fair experiment is carried through. An experiment will not be fair unless all the methods of starting any new business are tried. Such methods include liberal advertising and publicity, and small profits until trade is developed. To expect a waterway business automatically to spring full grown into successful financial competition with long-established railways is to kill it before it is well started.

There is a growing sentiment in favor of waterways in the United States, in spite of what appears to be good economic evidence against them. Strangulation of the one full-sized experiment will not kill off the growth of others. In justice to the whole transportation problem, on which the critical cost of living so depends, the New York canal system should have a fair chance to show what the modern inland waterway can do. It cannot have that so long as it is run entirely by railway men or is under divided control—or, worse yet, under an unprejudiced administration which considers it as a passive route ready for those who may want to use it. It must be administered by those who want to show that it is eventually to be successful. It first must be made known to the people who should use it, and then its use must be made attractive. If there is anything at all in the inland waterway idea, it is that the increased public first cost will be returned to the people in reduced final cost of the commodities which go over the waterway. Increasing that first cost a little, then, to make the proposition known, and to get it used, is only good business judgment.

Economic Balancing of Highway Excavation by a Semi-Graphic Method

Device Called "Trace Curve," Used in Designing Storm King Highway of New York State Highway Department, Is Particularly Useful to Supervising Engineers in Checking Earth Distribution

By Dudley P. Babcock
Assistant Engineer, New York State Highway Department, Albany, N. Y.

DETERMINATION of the economic distribution of excavated material in the location of the Storm King and other highways of the New York State Highway Department has been effected by a new method, utilizing what is called a "trace curve." The solution is partly graphic and partly analytical, and has for its underlying principle the assumption that for slight raising and lowering of cuts and fills the added and subtracted quantities are proportional to the surface areas multiplied by the change in elevation. The device is particularly applicable in new locations which are unhampered by existing improvements, and where the excavation quantities are large. By requiring his assistants to plot a trace curve of their grade design, the supervising engineer will find it easy to detect quickly any uneconomical balances and compute roughly, without recourse to the cross-sections, the probable saving which would result from any proposed change.

Selection of the grade and alignment of highways has ever been, and always will be, largely a matter of judgment developed by experience, rather than an exact mathematical science. This is evident because no formula can adequately represent the ground surface; also, the governing factors in determining grade and alignment are not only the economic haul and quantity of earth to be moved, but also involve the adjacent structures, trees, fences and roads, together with the maximum grades permissible in each direction, the drainage—and last, but not least, the æsthetic features. For example, wide shoulders, shallow ditches, fairly long grades with decided breaks, large vertical curves and a winding alignment will make a road attractive but not necessarily economical.

There are cases, however, where a road is to be built over rough country where no previous roads existed and where many of the factors mentioned above are either nonexistent or at least unimportant. After the maximum grade has been established on such roads, the principal factors affecting the design of the grade and alignment are reduced to two classes—the æsthetic and the economic. If the earthwork is comparatively heavy, which is often the case on roads of this type, a thorough study is warranted, to determine minimum hauls and excavation. The former may easily be determined by means of the mass diagram, but the latter, while seldom neglected entirely, does not receive the attention it deserves.

The trace curve may be defined as follows:

If upon the plan of a road in side-hill cut the traces formed by the intersection of the side slopes with the original surface were drawn, also the line of zero cut and fill; then if the zero cut-and-fill line were rectified and the above-mentioned traces were modified so as to bear the same relation to the rectified line that they bore to it before rectification, the result would be a trace curve. If the zero cut-and-fill line happened to be straight, originally, then the traces of the side slopes would be trace curves and no modification would be necessary.

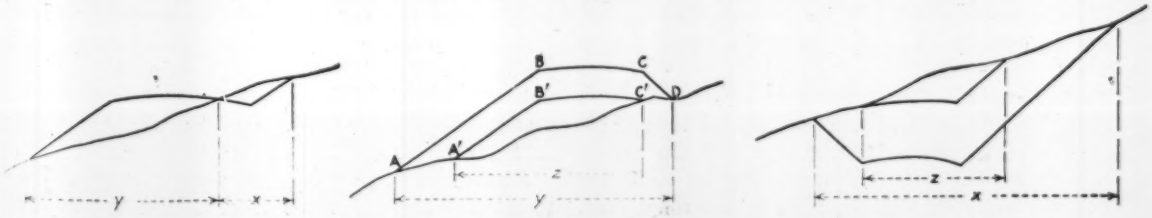
The trace curve is made by plotting center-line stations as abscissas and widths of cuts and fills of corresponding sections as ordinates. The cut widths are plotted above the datum line and the fills below, resulting in two curves—one normally above and the other normally below the datum line.

In the case of through cuts, the fill is assumed to be negative (i.e., plotted above the datum line) and equal in amount to the width of the cut minus the width which the cut would have if the grade were raised until the first iota of fill were introduced. In the case of through fills, the cut is assumed to be negative (i.e., plotted below the datum line) and equal in amount to the width of the fill minus the width which the fill would have if the grade were dropped until the first iota of cut were introduced. This may seem somewhat complicated, but, as a matter of fact, it is quite simple and takes but a moment to apply.

The following figures illustrate the matter:

In Fig. 1, x is the width of cut to be plotted above the datum line, and y is the width of fill to be plotted below. In Fig. 2, the section is assumed to be in through fill as shown by ABCD. Then y is the width of fill and is plotted below the datum line. To obtain the negative width of cut, drop the templet until cut is just about to be introduced at C′, as shown by A′B′C′. Then $y - z$ is the negative cut and is also plotted below the datum line. In Fig. 3, x is the positive cut to be plotted above the datum line and $x - z$ is the negative fill to be plotted above the datum line.

The meaning of these negative ordinates becomes apparent at a glance. By raising the grade of the



FIGS. 1, 2, 3. WIDTHS OF POSITIVE AND NEGATIVE CUTS AND FILLS

road shown in Fig. 1, the decrease in the value of x roughly equals the increase in the value of y, until the condition is reached as shown at A'B'C', where the value of x is reduced to zero. Assuming, however, that the same relation continues to exist between x and y as the grade is raised further, the value of x for the position ABCD is negative and equal to $y - z$. In like manner, when the grade is dropped it may be shown that the negative value of the fill width designated by y will be $x - z$.

Meaning of the Trace Curve

Primarily, the object of the trace curve is to determine the highway profile requiring the minimum quantity of excavation. It does not take the place of the profile nor the usual method of balancing cuts and fills, but simply furnishes the criterion as to whether the particular arrangement of cuts and fills in question (assumed to be balanced) gives the minimum quantity of excavation possible under the circumstances. For example, assume two adjacent stretches of highway, A and B, each a few hundred feet long, which have been grouped together to form a balance. Let

b = balance ratio;
C = total cut;
F = total fill.

Then

$$\frac{C}{F} = b.$$

Now assume that the grade is raised a small amount over the section A and lowered a small amount over the section B, the latter change being so related to the former that the balance ratio b is preserved. Let

c_1 = cut eliminated by raising the grade in A;
c_2 = cut introduced by lowering grade in B;
n_1 = ratio of fill introduced to cut eliminated in A;
n_2 = ratio of fill eliminated to cut introduced in B.

So that

$c_1 n_1$ = fill introduced in A;
$c_2 n_2$ = fill eliminated in B.

Then

$c_1 - c_2$ = net saving in cut;
$c_2 n_2 - c_1 n_1$ = net saving in fill.

But if the balance ratio is preserved after as before the change

$$c_1 - c_2 = b(c_2 n_2 - c_1 n_1) \qquad (1)$$

Now let

$$k = n_2 - n_1$$

or

$$n_2 = k + n_1.$$

Substituting in (1)

$$c_1 - c_2 = b(c_2 k + c_2 n_1 - c_1 n_1)$$
$$= bkc_2 - bn_1(c_1 - c_2)$$
$$(c_1 - c_2)(1 + bn_1) = bkc_2. \qquad (2)$$

From (2) we see that the saving in excavation is positive if k is positive, and it is negative (i.e., the change represents an increase in excavation) if k is negative. If k is positive then $(n_2 - n_1)$ is positive or n_2 is greater than n_1. Now, it may be easily shown that the values of n for small changes in grade are equal to the ratio of widths of fill to widths of cut. Thus, referring to Fig. 1, if the section is raised a *small* amount v, the increase in fill will be vy and the decrease in cut will be vx. Therefore,

$$n = \frac{vy}{vx} = \frac{y}{x}$$

i.e., n equals the ratio of width of fill to width of cut.

The method of using the trace curve should now be apparent.

Method of Applying Trace Curve

The road is first balanced roughly, using the profile and cross-sections in the usual way. The trace curve is then drawn, showing the widths of cut and fill plotted to any convenient scale vertically and the stations horizontally. The positive cuts are plotted above the x axis, the negative ones below and the fills vice versa, as described above.

Wherever the area included between the cut-and-fill lines drops below the x axis, the grade, if possible, should be lowered and then raised somewhere else where the reverse condition holds; for n for the grade being lowered is higher than n for the grade being raised, and $n_2 - n_1 = k$ is positive. Also, in general, wherever two adjacent stretches can be found where the values of n differ, the grade corresponding to the higher n should be lowered and the other raised to preserve the balance.

A few illustrations will serve to make the above more clear. First, assume perfectly level ground, transversely, and a profile as shown in Fig. 4. The road has been balanced between A and C. It will at once

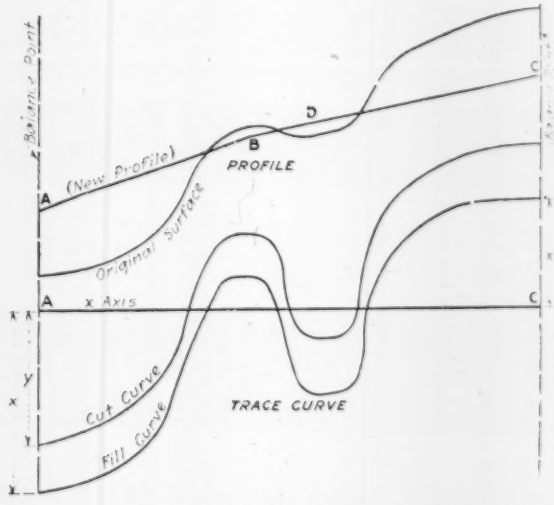


FIG. 4. FORM OF TRACE CURVE WHERE GROUND IS LEVEL TRANSVERSELY OF ROAD

be apparent from the profile that the grade as designed is uneconomical and should, if other conditions permit, be revised. If AB is already a maximum grade, it should be dropped bodily, thus eliminating a large amount of fill at A and introducing a smaller amount of cut at B. To restore the balance BC may now be raised, which will reduce the cut greatly at C, although introducing a small amount of fill at D.

Better yet, it may be possible to hold the B end of grade BC and raise the C end, thereby eliminating cut to even greater advantage. This is shown also

by the trace curve (Fig. 4). The uneconomical fill is shown at A by the fact that the area between the cut-and-fill line is below the x axis, and the uneconomical cut is likewise apparent at C because this area is here well above the x axis. In case the ground is level transversely (as assumed above), it is very evident that the trace curve is superfluous. Here the profile is all that is necessary for economical balance. If, however, the ground sloped transversely and with varying pitches in amount and direction between A and C, then the profile would be of little or no use for this purpose, and the trace curve alone would serve as the criterion for economical balance.

This last condition is shown in Fig. 5. Here the road is assumed to be in side-hill cut with the grade

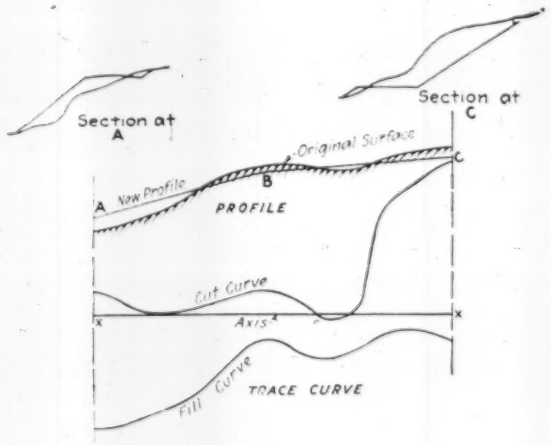


FIG. 5 FORM OF TRACE CURVE WHEN ROAD IS IN SIDE-HILL CUT OR FILL

profile following the center line very closely, but at A the fill side is very steep and the cut side almost level, whereas at C the reverse holds. An economical balance of the section AC requires the same changes of grade as in the first case—viz., the dropping of grade AB and the raising of grade BC. But, unlike the first case, the profile in no wise indicates the fact.

Fig. 6 shows a short section of the trace curve of an actual highway. It covers one balance, i.e., the cuts are in excess of the fills by the balance ratio assumed; in this case about 1½. A study of this trace curve will reveal the following characteristics:

1. Both the cut-and-fill curves follow the surface profile in a general way.

2. Through cuts occur when both the cut-and-fill trace curves lie *above* the x axis, as at A. Through fills occur when both curves lie *below* the x axis, as at B. When the x axis lies *between* the curves the section is partly in cut and partly in fill, as at C.

3. The distance between the curves at any point is a measure of the average transverse slope of the ground at the corresponding section. Thus, the transverse slope at D is much steeper than at A, B, or C.

4. When in through cut the distance between the cut curve and the x axis at any point is a measure of the total width of the corresponding cross-section, for example, rA. When in through fill the distance between the fill curve and the x axis is the measure of the total width of the corresponding cross-section, for example, uB. When the section is partly in cut and partly in fill, the measure of the width of section is the distance between the cut-and-fill curves, for example, xy.

5. The area included between the x axis and that portion of the cut curve lying *above* the x axis is the measure of the amount of cut obtained by lowering the grade uniformly a small unit amount. Thus, if this area $= M$ and the grade is lowered a small amount n (less than 1 ft.), then the amount of cut obtained by such lowering $= Mn$. Similarly, the amount of fill introduced by raising the grade uniformly a small amount q is measured by Pq where $P =$ the area between the x axis and the fill curve lying *below* the x axis.

The value of M or P may be obtained by the planimeter, or a transparent straight-edge may be laid parallel to the x axis and at such a distance from it that the areas included between the straight-edge and the curve will be about equally distributed above and below the straight-edge. This can be done by eye, involving an error of less than 1 ft. It gives the average ordinate of the curve, which, when multiplied by the station interval under consideration, gives the required area. The latter method is preferred. It is accurate enough and much quicker. In either case, all negative cuts and fills are taken as zero. Thus ee′, gg′, kk′ show graphically the average width of cut sections over the grades —4.6%, —0.36% and +4.8%, respectively, while ff′, hh′ and ll′ give the corresponding width of fill sections.

If a change of elevation of more than 1 ft. is made at any point, then the above method of determining the resulting change in yardage becomes very approximate, because the change in the trace curve itself becomes appreciable.

6. The ideal trace curve would be two lines parallel to the x axis.

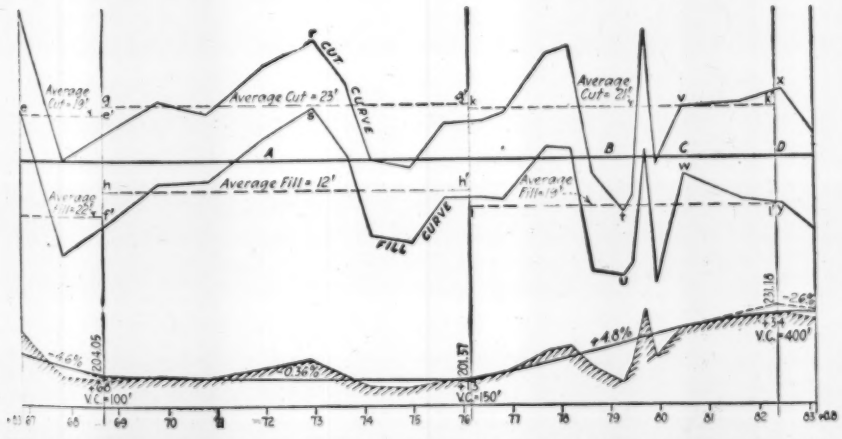


FIG. 6. METHOD OF APPLYING THE TRACE CURVE TO AN ACTUAL ROAD BALANCE

From the above statements it is evident that the trace curve not only indicates the efficiency of balance, but also affords a rough means of rebalancing a road wherever the curve indicates the need of so doing; and it gives the approximate yardage to be saved thereby, without reference to the cross-sections.

Application of Method to an Actual Case

The trace curve shown in Fig. 6 indicates a fairly satisfactory arrangement of grade, and the road is now being built on this design. It may be used, however, to illustrate the method of procedure in case the curve indicated the need of rebalancing.

By using the transparent straight-edge, as described above, the lines ee′, ff′, gg′, hh′, kk′ and ll′ were obtained, showing the following approximate average widths of cut and fill over the lengths of the various proposed grades:

From Station	To Station	Proposed Grade	Average Width of Cut	Average Width of Fill
66+83	68+68	−4.6%	19	22
68+68	76+13	−0.36%	23	12
76+13	82+34	+4.8%	21	19

Here the value of n for the −0.36% grade is lower than that for the +4.8% grade—for the former $n = 1\frac{2}{3}$ and for the latter $n = 1\frac{8}{9}$. Hence, for an economical balance, the −0.36% grade should be raised and the +4.8% grade lowered an amount sufficient to restore the balance. With side slopes of 1 on 1½ and level ground a change of elevation of 0.5 ft. will change cut and fill trace curves 1.5 ft. each.

Try, therefore, raising the −0.36% grade 0.5 ft. The calculation of the net saving in cut would then be:

Cut eliminated on the −0.36% grade would equal the product of the amount of the raise, the average width of cut and the length of the section raised, or

$$0.5 \times 23 \times 745 = 8568 \text{ cu.ft.} \qquad (1)$$

Likewise, the fill introduced would equal

$$0.5 \times 12 \times 745 = 4470 \text{ cu.ft.} \qquad (2)$$

In order to restore the balance ratio of 1.25, the +4.8% grade must now be lowered to introduce cut equivalent to

$$8568 + (1.25 \times 4470) = 14{,}155 \text{ cu.ft.}$$

Lowering this grade 0.5 ft. will introduce cut equal to

$$0.5 \times 21 \times 621 = 6520 \text{ cu.ft.} \qquad (3)$$

and eliminate fill equal to

$$0.5 \times 19 \times 621 = 5900 \text{ cu.ft.} \qquad (4)$$

or introduce equivalent cut of

$$6520 + (1.25 \times 5900) = 13{,}895 \text{ cu.ft.}$$

To introduce 14,155 cu.ft. of equivalent cut, therefore, lower the −4.8% grade by

$$\left(\frac{14{,}155}{13{,}895} \times 0.5\right) = 0.51 \text{ ft.}$$

Substituting 0.51 in (3) and (4) above, the cut introduced is 6651 cu.ft. and the fill eliminated is 6018 cu.ft., and, comparing with (1) and (2), a net saving in cut of 1917 cu.ft. and in fill of 1548 cu.ft. is obtained.

If preferred, the following formula may be used instead of the above method. It may be easily derived by substituting the proper symbols in the analysis and applying numerical values for the above case.

$$S = xl_1\left(c_1 - c_2\frac{c_1 + bf_1}{c_2 + bf_2}\right)$$

where

S = net saving in cut (cu.ft.);
x = amount first grade is raised (ft.) = 0.5;
l_1 = length of first grade (ft.) = 745;
c_1 = average width of cut over first grade (ft.) = 23;
f_1 = average width of fill over first grade (ft.) = 12;
c_2 = average width of cut over second grade (ft.) = 21;
f_2 = average width of fill over second grade (ft.) = 19;
b = balance ratio = 1.25;

giving S = 1926 cu.ft., which checks substantially with the other method. The total excavation for this balance happens to be 115,284 cu.ft. and the embankment 90,696. So the maximum possible saving is only about 1½%, and it would hardly pay to make the revision.

Thoughts on the Engineer's Relation To the Community

W. H. Finley, president and former chief engineer of the Chicago & North Western R. R., and president of the American Association of Engineers, spoke informally to an open meeting of engineers at New York Feb. 10. Ranging over the whole field of professional questions, he spoke of public service, of the engineer's backwardness in taking up his responsibilities to the community, of progressing through association, of the need for working upward from the bottom rather than down from the top in welding together the engineering profession, and of establishing the engineer on a recognized plane. Random extracts from the address are printed here as separate paragraphs. They add to the stock of thought on the development of the engineering profession.—Editor.

THERE is probably no profession of trained and educated men that has had such a rapid development and expansion as the engineer's. Our technical schools are now turning out engineers in shoals, almost, and I am afraid that as a profession they have hardly found themselves yet. They have lacked something in organization.

I have been quite surprised in looking up statistics to find, of the great number of engineers in the United States, how few of them belong to any engineering organization. It is really deplorable, because they need association. Take the vast body of young men coming out every year; they need encouragement, they need help. They must not think that the engineers after they attain some prominence in their profession forget the coming man, and the young man, and the man who has not yet made himself felt.

Strangers Among Their Fellow Men

Although we have so many engineers—and the number is growing constantly—yet they are very little known among their fellow men. They have always been the silent workers. They have not been very good ad

vertisers. But a certain amount of advertising never hurt anybody. In the earlier years we suffered from the belief of the older professions that advertising is unethical, but I think the engineer has outgrown that. A certain amount of advertising is good for the engineer, good for the community, and won't hurt him one bit.

The only thing is, we need some better way of defining an engineer. He has apparently no legal standing at all. Any one can hang out a shingle and practice engineering. That belief is wrong, and something should be done to correct it. There should be some way to define an engineer and some way to establish the fact that he is competent to practice his profession. The community needs it, and it is the duty of every engineer to give consideration to that fact.

Licensing on Broad Lines

It is a question in my own mind just what sort of license law engineers should have. I believe that they should be licensed not as specialists but on a broad ground, as in the medical profession or the legal profession. When a man passes a bar examination he doesn't pass it as an expert in corporation law or in criminal law; he passes it as a lawyer, having received the necessary fundamental training so that he can specialize afterward. It is the same way in medicine. When a man receives his diploma it does not say that he is an expert on the eye, ear and nose, or any other part of the human anatomy; it simply says that he has received the training and pursued the necessary studies to fit him to practice medicine, and he can afterward specialize in any branch that he chooses. It is a question with me whether engineers should not also be licensed on broad lines rather than on the narrow lines of any specialty.

Local Problems Before Engineers

We have a deplorable condition all over the United States, as far as engineers are concerned. We have it in the West and we have it in the City of Chicago. No doubt you have it here in New York. My attention not long ago was called to a condition in Chicago in the classified service of the city, containing a large number of engineers. For twenty years they haven't had an increase in salary, nothing more than the passage from one grade to another, with the result that the mechanic, the artisan and the tradesman that they direct are getting more than the engineer in charge of the work. That condition should not exist.

They have in that city a position of smoke inspector. The act creating it says it should be filled by a mechanical engineer; they appointed a dentist to the job. Not long ago they were to appoint a mechanical engineer in charge of a municipal plant; I think it is a plant costing about $2,000,000, and the act creating the position in the classified service said it should be a mechanical engineer's. They held a civil-service examination for it, but changed the classification so that any one could take the examination, with the result that a politician got the job, insead of a mechanical engineer.

That is all our concern. It is the concern of every engineer, and he should wake up to it. He should take an interest in his home affairs and in his civic affairs. He should see that these things are run the way they should be, and that positions which call for technical training and call for engineering skill are filled by engineers and not by politicians.

Responsibilities in the Labor Problem

It has always been my hope that the engineer would be the man to solve the questions of capital and labor, and successfully bridge the chasm between the two. There isn't a man who should understand labor better than the engineer, because labor is merely one of the tools he uses to carry out his ideas. It is just as necessary to him as the slide rule; his plans and his hopes and his promises could not be accomplished unless he employed labor.

No trained, educated, professional man comes closer to labor than the engineer. He certainly should understand labor better than any other man. I regret to say that apparently he does not.

In all the work that you handle, all the men that you direct, you should get closer to them. You should know their hopes and their aspirations and their desires, because they are making up this country just the same as you. I have never in my experience failed to find that the human touch meant more than anything else.

The human touch and the human feeling—it's the thing that's going to be necessary in the new condition that is coming over society. It is coming. We have got to have a better understanding with each other, and of each other and our fellow man, whoever he may be. As long as he is associated with us, and is a part of the force that is helping us to build up the country, we should understand him. We should analyze him and we should know him better than we do.

The engineer should really understand labor, should have been the leader of labor, the man whom they would look for advice and for help. But, I must say again, unfortunately the engineer has not been that man. Whether he has been afraid of himself or whatever the reason, he has not established that close relation with the men he was working with or that were working for him that he should have established.

Our Technical Societies

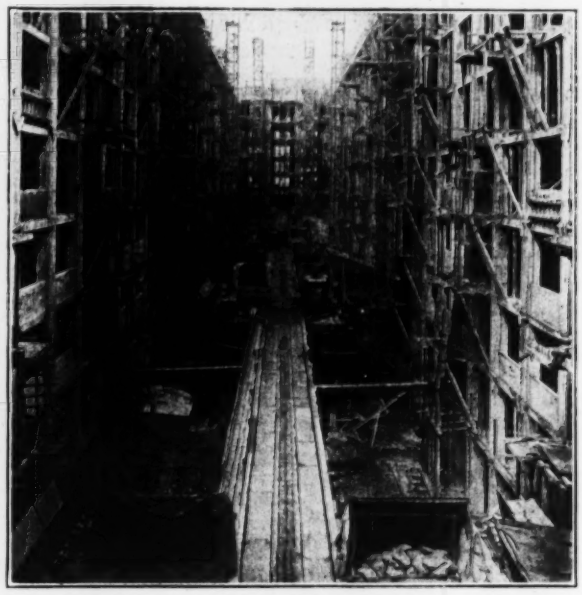
My connection with the activities of technical societies has led me to the conclusion that, as they are organized, technical societies cannot do the things that we hope and wish to do, without losing something. And I believe that the country needs technical societies, high-class, far removed from all the sordid things that we may have to take up as a business organization of engineers.

I have no quarrel with any engineering organization, particularly any of the technical organizations of engineers. I believe they fill a want in the community. I believe they should continue; I believe they should be encouraged to fulfill their destiny. But my experience is that if they are organized as technical societies for the advancement of certain purposes they are not able to accomplish the things that should be accomplished for the engineer. And that has been growing upon the engineers of the country.

Concrete Material for Army Base Hauled by Motor Trucks

Special Equipment Utilized at South Brooklyn Supply Unit for Stevedoring and Haulage—Truck Performance and Cost of Delivery Analyzed

STEVEDORING and hauling of concrete material for the South Brooklyn Army supply base was accomplished by the use of specially designed equipment, working in conjunction with motor trucks. To deliver the aggregate for 250,000 cu.yd. of concrete, concentrated in a relatively small area and in a limited time, required a flexible organization and a systematic layout, so that one part of the work would not obstruct another. The layout selected consisted of long timber trestles to give elevation at the various dumps, connected with return driveways so that the trucks might work continuously around the circuit without interference. By this system the contractors were enabled to deliver aggregate at the work over an average haul of ½ mile for a haulage cost of 21c. per cubic yard, and at a total unloading and haulage cost of 50c. When indirect charges, such as repairs to docks, etc., are included, the total was about 59c. per cubic yard.

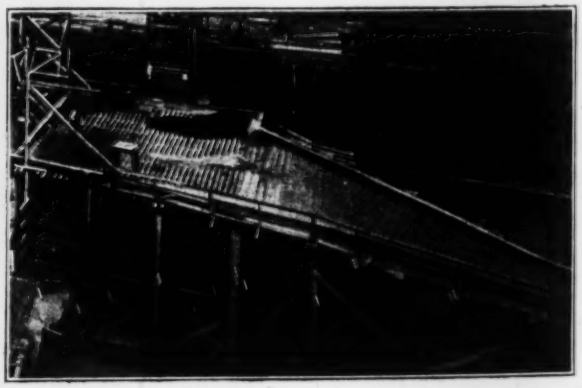


UNLOADING STATIONS ON WAREHOUSE B RUNWAY. CEMENT CHUTES IN FOREGROUND

The general dimensions of the warehouses, together with the excavation for them, were described in *Engineering News-Record* of Nov. 28, 1918, p. 993, and the design in the issue of Feb. 13, 1919, p. 317. The area covered by warehouse A was 196,000 sq.ft., that by warehouse B, 299,880, and that by the general office and power house 25,112 sq.ft. Each of the warehouses is nine stories high, including the basement and dock-floor levels, and the office building has four stories. The problem was to deliver the necessary material in this area with the required speed without causing congestion or piling it so as to obstruct traffic.

Two trestle runways about 25 ft. high and similar in design to those used for the construction of the offices of the War and Navy Departments in Washington, described in *Engineering News-Record* of July 4, 1918, p. 21, were constructed. They were built with heavy timber and strongly braced, the uprights and stringers being 12 x 12 in. A track on each side for the motor trucks, separated by wooden curbing, was formed by cross-planking over two closely placed 12 x 12-in. stringers. One trestle stretched along the east side of warehouse A, while the other passes through a central court of warehouse B, as shown in one of the views. A smaller one was used for office building work.

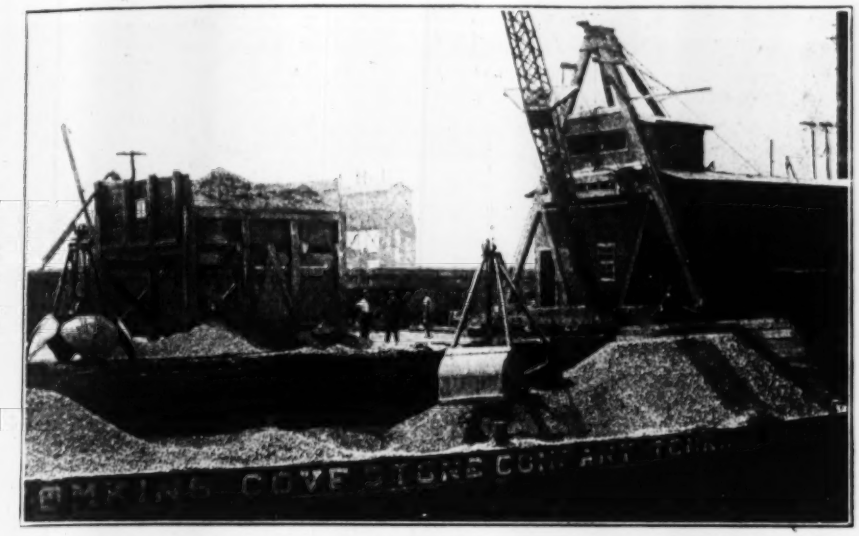
Four mixing stations were located under each trestle. Those on the warehouse A trestle had one 1½-yd. mixer to each station. Those on the warehouse B trestle had two mixers, one for each half of the building. The trestles widened out from 10 to 30 ft. at the stations, as shown, and were floored with 4 x 10-in. planks on edge and spaced 4½ in. This formed a grate under which were the material bins for stone, sand, grits and cinders, as the case might be. A view of one of these grates is reproduced. Sufficient elevation, so that the bins containing aggregate could discharge by gravity into the charging cars below and in turn into the mixers, was obtained by means of the trestle. A cement chute was provided at the end of each station, down which the cement in bags was dumped by the trucks to the loading and storage floors. Two of these chutes may be seen in the foreground of one of the illustrations. The single stations had bin capacity for 320 cu.yd. of crushed stone, 160 cu.yd. of sand and 160 cu.yd. of grits. Storage space for 4000 bbl. of cement was provided on the charging floor. Materials were delivered by barges at docks which were about ½ mile from the northern end of the buildings. It was planned to have the loaded trucks proceed to the southern end of either trestle, up an incline which was built on a 6% grade, pass along the trestle, dump at the proper bin, and go down the other incline, returning by way of First Ave., which lies between the two warehouses. This was the general plan followed out, although at the start, on warehouse B, it was necessary for the trucks both to go and come by way of



UNLOADING GRATE AND BIN AT MIXING STATION

First Ave., on account of the unfinished condition of the excavation at the southern end of the building. This caused some inconvenience, making it necessary to flag trucks in and out. The average round-trip distance was about one mile.

In all motor-truck operations, the secret of efficiency is to "keep the wheels turning," and this principle was



CLAM DIGGER TRANSFERRING STONE FROM SCOW TO TRUCK-LOADING BIN

recognized in the layout of the plant. Mechanical unloading and loading of material, combined with the almost immediate disappearance of the material at the grates—thus leaving a clear road—made it possible for the trucks to make the round trip almost without stop.

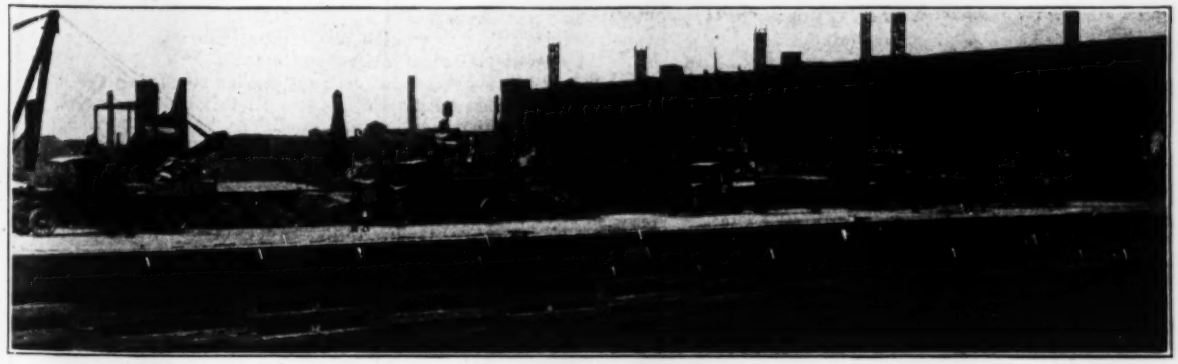
At the docks, the barges containing concrete aggregate were unloaded by two large skid diggers with clamshell buckets of about 5-cu.yd. capacity and two boom derricks with 1½-cu.yd. clams. The buckets dropped their loads into storage bins, as shown in an illustration. The bins were kept constantly filled, and the trucks were quickly loaded by gravity as they passed under the discharge. There were four of these bins, each having a capacity of 20 cu.yd., and the average length of time required to load a truck was about one minute.

Cement in bags was rapidly unloaded from the boats by conveyors designed and built by the general contractors. A battery of these is shown at work. By these conveyors the 110 bags required to make a load could be handled in 10 min. A full description of this apparatus, together with a special truck body which was used to some extent, appears on p. 396.

Although concreting began June 1 when the footings were started, the real rush commenced when the superstructure was begun July 3. From that date to Sept. 26, when the roof was completed, 183,173 cu.yd. of concrete were poured, or an average of 2130 cu.yd. per day. The maximum for any day's work was 4500 cu.yd. These large yardages of concrete required a proportionally greater yardage of loose material to be transported by the trucks. During the 64 days while the frames and floors of the buildings were going up, an average of 600 truck loads of material per 10-hour shift unloaded on the warehouse B trestle. Besides the hauling to buildings, large quantities of material were put in storage piles as insurance against shortage. While this required rehandling, it was considered worth while, to obviate any chance of delaying the completion of the contract. Piles were formed by starting a dump of the required width and gradually building up on a grade of 7 or 8 per cent., smoothing it out and planking the surface as the pile grew. The trucks would back up the grade and dump over the end of the plank. By this means, a pile containing from 9000 to 10,000 cu.yd. of crushed stone was kept stored,

TABLE 1.—TRUCK PERFORMANCE IN HAULING TO BUILDING SOUTH BROOKLYN ARMY SUPPLY BASE FROM JULY 10 TO NOVEMBER 14, 1918

	Sand and Stone	Gravel	Grits	Cement
Average haul, round trip, miles	1	1	1	1
Auto truck hours	17,384	71	646	7,651
Auto truck loads—trips	59,899	152	2,014	12,615
Average trips per truck per hour	3 40	2 1	3 1	1 64
Average miles per hour	3 40	2 1	3 1	1 64
Cubic yards moved (boat measure)	246,131	621	8,519	1,308,225
Average load per truck, cubic yards or bags	4 1	4 2	4 1	194



BATTERY OF CONTINUOUS-BELT CONVEYORS TRANSFERRING CEMENT FROM BOATS TO MOTOR TRUCKS

TABLE II.—COST OF STEVEDORING, HAULING AND RE-HANDLING MATERIALS FOR CONCRETE SOUTH BROOKLYN ARMY SUPPLY BASE, FROM START MAY 26 TO NOVEMBER 13, 1918.

Items	Unit	Amount	Stevedoring and Hauling — Direct Cost — Labor Loading, etc. Total	Labor Loading, etc. Unit	Hauling by Trucks Total	Hauling by Trucks Unit	Loading Plant Rental Total	Loading Plant Rental Unit	Supplies Total	Supplies Unit	Supervision Field and Office Total	Supervision Field and Office Unit	Commission Total	Commission Unit	Indirect Cost on 380,000 Cu.Yd.—Building, Repairing, Removing Plant and Towage Summary Total	Summary Unit	Charges Total	Charges Unit	Grand Total Total	Grand Total Unit
Aggregates	Cu.yd.	*337,481	$34,217 14	$0 10	$72,015 95	$0 214	$26,571 86	$0 079	$20,635 59	$0 061	$6,766 48	$0 020	$9,740 14	$0 029	$169,947 16	$0 504	$32,193 74	$0 085	$202,140 90	$0 589
Cement	Bbl.	393,692	3,861 86	0 01	28,772 50	0 074					900 52	0 002	1,943 35	0 005	35,478 23	0 090	4,329 95	0 011	39,808 18	0 101
									Rehandling											
Aggregates	Cu.yd.	* 26,749	10,228 13	0 382	10,437 50	0 39	4,056 50	0 15	1,051 00	0 039			1,325 89	0 049	27,099 02	1 01				
Cement	Bbl.	22,330	1,956 76	0 086	1,441 00	0 065							104 01	0 005	3,481 78	0 156				

*Quantities comprise stevedoring and hauling to building of following: Sand 122,949 cu.yd.; stone, 193,832 cu.yd. remainder being grits, cinders, paving blocks, coal and gravel. Rehandling covered 6,790 cu.yd. of sand, 19,355 cu.yd. of stone and 604 cu.yd. of grits.

so that when it was needed the material could be reloaded by steam shovels working upon the last material stored, which in turn could be replaced.

The hauling was carried on by subcontract under the cantonment form for emergency work. The subcontractor was required to furnish all hauling equipment, labor and supervision. He was paid a rental for his plant and a commission not to exceed a fixed sum on the payroll and supplies.

Accurate costs were kept for the Government by the general contractor, who also kept close account of the performance of the trucks, in trips per hour, average load per truck, and mileage covered. A record of this performance is shown in Table I. Although the mileage covered per hour by the trucks appears low when contrasted with mileages covered on the highway, this may be easily explained by the impracticability of high speeds, the time for loading and unloading, and the delays due to various causes, such as train interference where the trucks passed over the switching tracks. The average load carried per truck was 4.1 cubic yards.

Table II gives the cost of hauling and rehandling materials. These costs do not include the construction of the timber trestles or the loading and unloading bins, which were charged to concrete. All other charges such as supplies, field and office supervision, and a commission of 6½ per cent., together with repairs on the plants, are included.

In Table II, which shows the unloading and hauling costs, the actual hauling cost per cubic yard is shown to be about 21c. Taking the average haul at ½ mile, the cost per ton-mile would be about 16c. The total cost of hauling and handling, including all charges, would be about 44½c. per ton. Hauling cement cost 7.4c. per barrel, while the total cost for handling and hauling, including all charges, was 10c. per barrel. Rehandling covered picking up material from the emergency supply dumps and carrying it to the work. The cost of this rehandling was considerably higher than was the cost of the original handling of the material.

The work is being done by the Construction Division of the Army. Brig. Gen. R. C. Marshall, Jr., is chief of the Construction Division, Lieut. Col. H. S. Crocker is constructing quartermaster, and Maj. George Perrine, Quartermaster Corps, National Army, assisted by Capt. J. W. McCathon, was directly in charge of the part of the work described. The general contractor is the Turner Construction Co., New York City, of which A. C. Tozzer is executive manager, and the subcontractor for the hauling is Rodgers & Haggerty, of New York City.

University Dean Urges Better Conditions for Railway Engineers

DR. C. R. RICHARDS, dean of the College of Engineering of the University of Illinois, has written the following letter to the Board on Railway Wages and Working Conditions of the United States Railroad Administration:

I have read with much interest the astonishing article entitled "Pay and Position of Engineers in Railway Service," by Charles Whiting Baker, which appeared in *Engineering News-Record* of Jan. 30, 1919, p. 228. While I have long realized that the railroads of this country offer few inducements which render the transportation service a particularly attractive field for engineers, I had not supposed that present conditions are as bad as Mr. Baker's article indicates.

Believing that the transportation interests of the country are fundamental to its growth and industrial prosperity, the University of Illinois has done much to promote the scientific study of problems relating to both the engineering and the administrative work of the railroads. Thus, the College of Engineering offers specialized curriculums in railway civil engineering, railway electrical engineering and railway mechanical engineering, and the College of Commerce and Business Administration offers curriculums in railway administration and railway transportation. To coördinate the administrative and engineering work, we have a School of Railway Engineering and Administration.

In spite of facilities for instruction which are not surpassed anywhere, very few students are attracted into these railway engineering and transportation courses. However fascinating this work may be to the average young man, it is generally recognized that the railroads of the country apparently have so little appreciation of technical and scientific training that they are unwilling to pay to trained experts salaries which are comparable with those offered by industrial corporations.

When a young man asks my advice regarding the opportunities for a successful career in this field, I feel obliged to tell him what the real conditions are. You cannot expect a young man to spend four years in college, with a more or less indefinite apprenticeship thereafter, to prepare himself for a position in the engineering department of a railroad at a salary below that of clerks and mechanics and very much below the salary paid to trainmen. It has been my hope that one of the effects of Government control would be to improve the status of trained experts. In my opinion it is vastly important that the railroads of the country apply the soundest engineering and economic principles in the conduct of their business, for I am convinced that it is only by such means that they will be able to maintain an efficiency which will be satisfactory to their stockholders and to the public.

Material Prices Halt Chicago Building Operations

Costs $1,873,239 Today to Erect a Building Costing $1,000,000 in 1915—Wage Increase Only Partial Cause

By O. M. Fox

BUILDING construction is slow in recovering from the depression caused by the war. When the fighting stopped last November an immediate increase in building was prophesied. Work costing millions of dollars was announced ready for contract as soon as war restrictions were removed. Today, more than three months after release from the stress of hostilities, there is no building under way, nor is any construction announced for the immediate future, except some few improvements which are absolutely indispensable.

Analysis of the construction cost of a hypothetical building at present prices, compared with a similar enterprise carried out in 1915, may perhaps set us on the track of the correct answer.

The accompanying tabulation shows actual costs on a building which was erected in Chicago in 1915, compared with the costs of the component parts thereof as of today's market prices and wages:

	Actual 1915 Costs	Ratio	Estimated 1919 Costs
Masonry	$175,400	1.52	$266,608
Steel, material	100,700	3.15	317,205
Steel, erection	20,100	1.29	25,929
Foundations	81,100	1.54	124,894
Elevators	74,000	2.00	148,000
Carpentry	73,800	1.86	137,268
Ornamental iron work	62,600	2.20	137,720
Heating and ventilating	62,100	1.92	119,232
Fireproofing	47,000	1.70	79,900
Engines and generators	41,000	2.00	82,000
Plumbing, drainage	30,800	1.54	47,432
Electric wiring	29,500	2.00	59,000
Terra cotta	26,500	1.70	45,050
Various minor items, e.g., glazing, hardware, roofing, painting, lighting, etc.	129,200	1.50	193,800
Architects' and engineers' fees	46,200	....	89,201
	$1,000,000	1.87	$1,873,239

These figures of ratio of 1919 costs and the resulting estimates were arrived at in the following manner:

Masonry—Each thousand dollars of expenditure in this division of the job is split as follows:

Item	Cost per Unit, 1915	Amount	Cost per Unit, 1919	Amount	Per Cent. Advance
Brick	$7.50	$535.70	$12.00 M.	$918.73	71.5
Lime	1.50 bbl.	107.20	1.80 bbl.	128.64	20.0
Sand	1.35 yd.	35.70	2.10 yd.	45.41	27.2
Skilled labor	.75 hr.	160.70	.87½ hr.	193.49	16.7
Common labor	.40 hr.	160.70	.57½ hr.	230.93	43.7
		$1000.00		$1517.20	51.7

Foundations—Concrete caissons were placed under the structure. The division of expense on this class of work per $1000 is as follows:

Item	Cost per Unit, 1915	Amount	Cost per Unit, 1919	Amount	Per Cent. Advance
Cement	$1.02 bbl.	$353.00	$2.05 bbl.	$709.53	101.0
Sand and gravel	1.35 yd.	401.00	2.10 yd.	510.07	27.2
Skilled labor	.65 hr.	115.00	.75 hr.	132.71	15.4
Common labor	.40 hr.	131.00	.57½ hr.	188.25	43.7
		$1000.00		$1540.56	54.1

Steel—Steel was furnished on the job in question at $36.50 a ton, f.o.b. Chicago, while current bids on a proposed job range from $110 to $120, or an average advance of 317 per cent. Structural-steel setters' wages in 1915 were 68c. and are now 87½c., an advance of 28.7 per cent. As exact figures are available for a separation of this item into material and erection, it is so shown.

Elevators—In line with all other machinery, elevators are costing approximately twice what they did four years ago, as are also engines and generators.

Carpentry—The price of yellow pine in 1915 was $18, against a quotation of $45 today. The local carpenters' scale was 65c., contrasted with 80c. at present. Allowing half the cost under this head to apply to material and half to labor, we find the cost to have advanced 86.5 per cent.

Ornamental Iron Work—This consisted mainly of iron and labor, in proportion of three to one. With a 150% advance in iron, from $14 to $34.75 per ton, and a 30% advance in iron setters' wages, from 67½c. to 87½c. an hour, the increased cost of this class of work aggregates 120 per cent.

Heating and Ventilating—Iron has advanced from $14 to $34.50 a ton, or 147%, and labor from 75c. to 81¼c. or 9%. Allowing this cost to be split 60% material and 40% labor, we find the advance under this head to be 92 per cent.

Fireproofing—Tile shows a cost increase of 100% from 3½c. to 7c. per foot on a given size, and labor an increase of 9%, from 75c. to 81¼c. About two-thirds of the total cost of fireproofing being material, we find the advance to date to be 69.6 per cent.

Plumbing and Drainage—Metal markets have advanced thus: Lead from $3.80 to $6, brass from $15 to $31, copper from $13 to $23 and iron from $14 to $34.50. The plumbers' scale was 75c. and is now 81¼c. Figuring the average metal advance to have been 100% and the labor 8⅓%, and figuring material at half and labor half of the whole, the resulting increase in cost figures 54.2 per cent.

Electric Wiring—Without troubling to go into detailed figures, it is safe to say that the various lines of conduit and flexible duct have advanced to 2½ times their cost of four years ago. Copper wire has doubled, as have also practically all other elements of this work except labor, on which the scale has advanced 16%. It is, therefore, reasonable to assume that the cost under this head will average double that of the other job.

Terra Cotta—Although the market in this commodity is somewhat deranged at present, no actual quotations being available, it is probably safe to assume that the increase in its cost is very similar to that of fireproofing and it has been so figured.

Minor Items—Too much space would be consumed in analyzing all of the lesser items of construction cost in this short exposition. It is sufficient to say that they have been carefully studied, and that the average increase of 50% as figured in the table is conservative in the extreme.

Architects' and engineers' fees, of course, increase in exact proportion to the average increase in the various other items.

The hypothetic cost figured above has been compared with the actual costs on several jobs of varying grades which have been recently put under way, and are found to be remarkably close to the actual, the slight difference being, in each case, in the direction of greater advance.

We, therefore, arrive at the conclusion that a building

erected today to compete with the $1,000,000 "before-the-war" structure would cost $1,873,239, or an advance of 87.3%. As the older structure has to bring an average rental of $2 per square foot in order to return from 4½ to 6% on the investment, it is apparent that a rental of $3.75 will be necessary in its new competitor, and as the obtaining of such a rental in Chicago is obviously impossible, therein seems to be the reason why building construction is not being undertaken.

The particular subject of this study happens to be an office building, but what is true of a modern office building is equally true in the case of a factory, a hotel, an apartment or a home. The present cost of buildings in all lines is such as to be practically prohibitive.

New York Barge Canal's First Operating Season

One Federal and Two State Officials Report Independently on Canal Operations Under Federal Control, and Give Reasons Why It Carried Less Freight Last Season Than Ever Before

ON APRIL 22, 1918, the United States Railroad Administration created the New York Barge Canal Section and authorized the construction and acquisition of equipment for use on the state system of canals which, it was expected, would be opened complete for the first time some time in May. The Federal Government did not take over the canals as a whole, as was commonly believed at the time, but it did assume control of rates, and purchased and leased floating equipment which it proposed to operate. The season opened May 10 and closed Dec. 12, the longest since 1907. In spite of this long season, the recognized necessity for freight carriage and the fact that the canal enlargement was complete, the business done was less than in 1917, which in turn was the smallest in the canal history.

The history of the year is now available in three separate reports, one by W. G. McAdoo, director general of the Railroad Administration, one by Frank M. Williams, state engineer of New York, and the third by W. W. Wotherspoon, superintendent of public works of New York. Enough of the three reports is given here to explain the conditions of the canal operation and to expose certain divergencies of opinion between the state and Federal authorities.

Comparative statistics of freight carriage on the completed Barge Canal system in 1918 and the combined Barge Canal and Erie Canal in 1917 are given in one of the accompanying tables, and total tonnage figures for the past 10 years in the other.

Report of the State Engineer

The State Engineer of New York is responsible for the construction of the canal. When sections are complete he turns them over for operation to the Superintendent of Public Works. As an introduction to the story of the operation, therefore, there is given here a part of State Engineer Williams' report for 1918:

In my report of a year ago I promised that the new canal would be opened to navigation throughout its entire length on May 15, 1918, and that it at that time would have been constructed to its full depth of 12 ft. That promise was fulfilled, even in spite of the fact that more numerous and greater difficulties arose to defeat the accomplishment than were anticipated when the promise was made.

Under the authority conferred upon the President of the United States to take over and operate canals and their floating equipment, and in accordance with the Federal plan to assume control of the transportation media of the country, the United States Railroad Administration assumed control of the canals in a somewhat limited manner. According to our state constitution the canals must remain forever the property of the state. The state has always maintained and operated them and during Government control it has continued to do this, the same as heretofore. Unlike its administration of the railroads, the Federal Government was not called upon to assume certain financial obligations in connection with the canal. What it did was to take over control, either directly or indirectly, of the floating equipment on the canal. It obtained control of a large proportion of the boats which had been in use on the canal during recent years, although the whole number of such available craft is not large, and it built a few new boats, which were just beginning to be delivered when the navigation season ended.

However, the Government became more than a mere transportation company; it stood ready to control all shipping on the canal, assuming the right under authority of Congress to commandeer any and all boats doing business on the waterway and even to direct the activities of those it did not commandeer. In fact, for some time the impression was general among the independent boatmen that the Government would not permit them to operate on the canal. Of course, the Government had no authority to grant or withhold permission to float a boat on the canal. Such authority rested solely in the Superintendent of Public Works of the state and could only be exercised by him. However, the Government could fix canal rates and it proceeded to do so. Much criticism has been aroused by this fixing of an arbitrary rate for interstate traffic approximately 20% less than the railroad rate. It is claimed that this is not based on operating expense and that the differential in favor of the canal would be much greater if the rates could adjust themselves as they had heretofore. The fleet of boats operated by the Government was entirely inadequate, both in number and dimensions, to test the canal's capacity. The new boats which were ordered built were not delivered in time.

The canal was handicapped during the season by much misinformation regarding its condition and possibilities for use, which was spread broadcast, perhaps without malicious intent, but generally without any basis in fact. That the Barge Canal should be completed to a point which permitted its full utilization seemed beyond the belief of many who had noted the long years during which it had been under construction. Entirely new navigation conditions aroused the timidity of the man accustomed to navigation on a shallow, restricted channel. His fears or ignorance often gave rise to false stories of conditions. The mere fact, however, that there have been brought through the entire line of the canal boats having a width of not less than 30 ft. and drawing 9½ ft. of water, as shown by the records of the office of the Superintendent of Public Works, should indicate that the canal is, as claimed, in a condition to accommodate the size of floating equipment for which it was designed and constructed.

Superintendent of Public Works Wotherspoon's comments on operation are partly as follows:

One who studies the record made during the first season of operation of the improved waterways and analyzes the freight movement can take no discouragement from the results attained, in spite of the fact that the total tonnage

fell below the 1917 business by 137,955 tons. He cannot fail to be impressed with the many indications of the rehabilitation of the canals as a commercial factor.

The figures covering the past 10 years of canal navigation show a steady annual decrease, amounting yearly to more than 15 per cent. The opening of the new waterways, while not reversing such process, has arrested the decrease so that the total for 1918 is only about 9% under that of the previous year. Were it not that extraordinary conditions existed, due to the war, it is believed the 1917 tonnage would have been exceeded. This statement is made in view of the great falling off in items of freight whose production was mainly dependent on labor which could not be secured owing to the military draft.

Another feature that stands out prominently is the comparatively small west-bound canal shipments. The decrease must primarily be attributed to the disturbed commercial conditions. A large portion of the industrial activity in the canal territory was in connection with what has been termed "war work." The industries working on war contracts for the most part drew their raw materials from Western producing centers, principally the iron and steel districts. Practically all of the raw materials, therefore, which were consumed in canal territory moved in an easterly direction to the mills, and when manufactured, continued east to seaboard. In normal times the markets of industries in the canal zone extend to the middle and northwest and the flow of west-bound traffic is heavy. During the past year the market or consuming territory was overseas or the military camps adjacent to the Atlantic seaboard. The normal west-bound traffic was naturally affected. Then, too, the discontinuance of imports due to wartime conditions had its effect on the canal business.

In a study of the record of the total business done in the past five seasons the through freight has averaged 27.6% of the total, and the way freight 72.4% annually. For the four years previous to 1918 the total was divided on averages of 25% of through freight and 75% of way freight. In 1918, however, the through freight represented nearly 40% of the total, and the way freight about 60%, thus showing that the long-haul traffic, which is the most desirable from the standpoint of revenue to the carrier, has greatly increased. This again evidences the restoration to the canal of a class of commerce which is much to be desired.

The falling off in shipments over the Oswego, Cayuga and Seneca, and Black River Canals was due to the fact that no service was offered to shippers in those territories, the Federal authorities confining their operations entirely to the main or Erie Canal. In previous years the Oswego, Cayuga and Seneca, and Black River Canals contributed approximately 10% of the total tonnage. During the past season the percentage of contribution of all three lateral canals amounted to only 3.9% of the grand total. [4.9%, according to figures.—EDITOR.]

On Apr. 18 formal announcement was made by the Director General of Railroads of his intentions to secure boating equipment and establish an operating organization to utilize the state canals. A complete organization was effected, with headquarters in New York City, and representatives at various points along the line of the waterway. Approximately 200 of the old-type canal boats were acquired by the Federal authorities by charter. A few tugboats were purchased and a number of others leased for the season. It was announced that operations would be extended to Erie Canal freight only, for the reason, I assume, that the transportation business on the Champlain Canal was well organized, and because the traffic movement in which the Federal Government had the greatest interest moved to the seaboard by way of the Erie Canal.

At the opening of the season, it became apparent that the plans adopted included only the transportation of bulk freight, particularly grain and grain products from the West. While recognizing the supreme importance of this class of traffic and its relation to the nation's military program, I believed that such utilization of the New York canals by the national Government to the exclusion of traffic produced and consumed by shippers located along the

TABLE SHOWING TONNAGE CARRIED ON NEW YORK CANALS IN 1917 AND 1918

Year	Branch	East-bound	West-bound	Total	Total Is Made up of: Through	Way
1917						
185 days open	Erie	518,608	156,475	675,083	76,981	598,102
	Champlain	332,561	183,193	515,754	158,931	356,823
	Others	62,453	43,935	106,388	41,554	64,834
	Total	913,622	383,603	1,297,225	377,466	919,759
1918						
216 days open	Erie	577,155	90,219	667,374	148,353	519,021
	Champlain	296,833	137,951	434,784	293,726	141,058
	Others	15,791	41,321	57,112	4,676	52,436
	Total	889,779	269,591	1,159,270	446,755	712,515

waterway from Buffalo to the Hudson River was unfair to New York State's interests. I have always taken the position that since the canals have been built solely by this state, its citizens were entitled to the full benefit of them and to that end, in addition to the movement of Government materials and supplies, some of the boats under Federal charter should be placed at the service of industrial establishments having freight for shipment. The soundness of these views was recognized by the Federal manager, and early in July a fast freight carload and less-than-carload merchandise service was inaugurated, serving some of the larger cities along the route.

During the first few weeks of the season some opposition developed to what seemed to be a monopoly by the Railroad Administration of all Erie Canal traffic. A conference with shipping interests was called in the latter part of June in the City of Albany, at which this question and the rate level were discussed. At that time, the Federal manager formally announced that there was nothing in the Director General's policy, as it would be carried out, which would prevent entrance of freight-carrying companies into the canal transportation field. The season being well advanced, however, no new companies made their appearance, and the Federal Government continued to be the only carrier operating on the Erie Canal.

The freight carried amounted in all to approximately 210,000 tons, or about 18% of the total of all the canals, and approximately 30% of the Erie Canal tonnage. It was made up of the following items: Wheat, salt, general merchandise, flaxseed, flour, pig iron, copper, coffee, barley, oil meal, oats and other commodities.

Due credit should be given to the canal operations of the Federal officials for some excellent results obtained, in spite of the fact that their work progressed under many handicaps, due to the inadequacy of the available boating equipment and the lack of suitable motive power. To this latter cause may be attributed the excessive time consumed in making passage through the waterway from Buffalo to the Hudson River. With proper equipment five or six days should be ample for the trip. Of 209 grain cargoes loaded at Buffalo, the fastest time recorded for passage to the Hudson River by the Federal boats was 10 days, and the average time consumed was something over 18 days. There is a record of barges having been in transit much in excess of that number of days. It is true, perhaps, that no urgent need existed for a speedier delivery, but in the interest of the rehabilitation of canal commerce it is to be regretted that effort was not made to establish records for trips which would furnish a guide for the carriers of the future.

The excessive time required for the passage of some of the boats can be attributed also to the disinclination, and in many cases the positive refusal, of boatmen to navigate the canal by night. No good reason existed for this other than the difficulty of obtaining additional crews. An elaborate system of lights was maintained on each side of the channel where necessary, and the navigable conditions were equal to those existing on any natural waterway.

REPORT OF THE RAILROAD ADMINISTRATION

The difficulties surrounding operation make up the larger part of Mr. McAdoo's report, the greater part of which is given below:

Contracts were early let for the construction of 51 steel barges, 150 ft. long, 21-ft. beam and 12-ft. molded depth, for service on the Barge Canal, at a cost of $1,697,708, and

TABLE SHOWING TONNAGE CARRIED ON NEW YORK CANALS IN PAST 10 YEARS

Year	Days Open	Total Tonnage
1909	185	3,116,536
1910	185	3,073,412
1911	185	3,097,068
1912	185	2,606,116
1913	172	2,602,035
1914	201	2,080,850
1915	200	1,858,114
1916	200	1,625,050
1917	185	1,297,225
1918	216	1,159,270

for 21 concrete barges of similar dimensions for $458,996.

[None of these barges was delivered for the 1918 season.—EDITOR.]

In addition to these contracts, five tugs were purchased, for a total of $56,500, and three wooden barges were purchased on the stocks for $52,650.

During May the general manager had under lease 13 steamers and 118 barges; during June, 14 steamers and 140 barges; during July, 14 steamers and 168 barges; during August, 14 steamers and 175 barges; during September, 14 steamers and 180 barges; during October, 12 steamers and 188 barges; during November, 12 steamers and 180 barges. The average time these vessels were under lease was 27 days per month. All this equipment was of the type that had been in use on the New York Barge Canal for many years, the vessels being designed to draw not more than 8 ft. of water. The 250-ton barges were chartered at $11 per day, including crews; the larger barges at $15 per day, including crews; the steamer and push boat at $50 per day, including crew but not including fuel and oil.

It will be noted that the fleet was gradually increased from the opening of navigation, with the expectation that in July and August a heavy east-bound canal business in grain would develop, as was anticipated by the United States Food Administration Grain Corporation. As a matter of fact this grain was shipped by the owners by rail.

The additional charters were not always completed the first day of each month and the record shows that from May 10 to Dec. 1 an average of 169 barges were in service. The period covers 203 days, so the operation covered 34,307 boat days.

Vessels of the fleet were idle on account of no cargoes as follows:

	Days
May	1,130
June	905
July	448
August	531
September	118
October	192
November	43
Total	3,367

The total number of serviceable boats on the New York Barge Canal is estimated at 760. The fleet not under Federal operation was engaged very largely in short-haul work, while the administration fleet was engaged exclusively in through service. The independently operated boat made its own transportation rate.

At the beginning of operation by the Railroad Administration it was found by actual experience that the minimum depth of the canal did not permit loading vessels to a draft in excess of 7 ft., and up to the close of navigation not more than 8½ ft. was available. The terminals at Buffalo and New York were not completed by the state and are not yet completed, so that the Railroad Administration was required to create temporary terminals. Rochester is as yet accessible only through the old canal, and Syracuse was not accessible by the new canal until September.

The inadequate equipment, which on account of war conditions was all that was obtainable for the past season, and the incomplete state of the canals and terminals, of course made the operating conditions very different from what they will be with new equipment adapted to the new canal and with the canal facilities completed, so that the operating results for the present year are not a measure of what may reasonably be expected in the future.

The movement of freight on the New York Barge Canal by all transportation agencies this season will approximate 1,200,000 tons, about the same volume as last year. Commodities such as building materials, pulp wood, road metals, coal to Canada, etc., always constitute a considerable percentage of the total traffic. The movement in these items decreased 250,000 tons. This decrease may be attributed directly to the war. Owing to the shortage in Northwestern grain crop of 1917, it was impossible during 1918 to obtain any cereal for shipment from Buffalo via the canal until late in September. Grain must always be a very large tonnage factor on the barge canal, and the crop shortage of 1917 was a serious handicap to the usual activities of 1918. Imports were almost entirely cut off at the port of New York and the west-bound movement of freight on the New York Barge Canal has been negligible.

An effort was made to stimulate a movement of coals. Manufacturing enterprises along the waterways were solicited to arrange for the receipt of water-borne coal at their plants. Many receivers said they preferred delivery by rail. There is practically no coal unloading equipment at canal bank, and receivers would not purchase the necessary machinery. It was, therefore, impracticable to construct loading tipples without some assurance they would be of value.

Because of the lack of suitable canal terminals in the port of New York, the barges were compelled to await the convenience of ocean vessels, and as the supply of ocean ships was intermittent, great delays were encountered in discharging cargoes. The lay time at terminals amounted to 1445 days.

The average running time between Buffalo and New York was 18 days towed by tugs, and 13 days for vessels towed by steamers. The average loading or unloading time was five days. The number of loaded boats dispatched during the season follows:

	Westbound	Eastbound	Total
May	14	17	31
June	15	93	108
July	62	78	140
August	50	101	151
September	40	113	153
October	33	139	172
November	12	89	101
Season total	226	630	856

A packet-freight service between Buffalo and Albany was established. Agencies were established in 11 cities. In view of the fact that only small unserviceable packet-freight ships were obtainable, satisfactory financial results were not expected or realized. The service was maintained until Nov. 1. Most of the freight offered was extremely bulky.

When navigation opened freight rates were established all-rail basis, both for local New York State traffic and for interstate traffic. The public was adverse to using the canal at all-rail rates. At the time all-rail rates were in effect on interstate traffic on the canal, the Canada Atlantic Line was maintaining a differential under standard all-rail rates of 10.8.6.4.4.3 on the various classes and commodities. All-rail rates continued until June 25, 1918, when on local New York State traffic a differential of 20% under all-rail rates was authorized. On interstate traffic for points beyond Buffalo to which we had through rates a differential under the all-rail rates of 10.8.6.4.4.3 was promulgated.

There has been a demand for a greater differential between the canal and the rail rates. In view of the actual cost of conducting the transportation on the canal during the past season, a greater differential appeared to be unjustified. The question whether there should be any readjustment of the differential is receiving consideration.

During the season we have handled a total of 194,201 tons at total gross freight revenue of $522,883.50. These tonnage and revenue figures will be slightly changed when our season is finally completed. This tonnage represents a much larger proportion of the total traffic carried on the canal than would be indicated by a comparison with the total tons carried by all transportation agencies, because a large proportion of the Railroad Administration business is through business, whereas other agencies are more largely engaged in local traffic, so that the average distance is much greater on the Railroad Administration traffic.

War's Influence on the Garbage Pail

F. C. BAMMAN
Consulting Engineer, Washington, D. C.; Formerly Chief of the Garbage Utilization Division, United States Food Administration

The amount of garbage collected during 1918 averaged about 10% less than that collected in 1917. Collections during the summer months of 1918 also averaged about 10% less than for 1917; compared with 1916, the reduction was 22½ per cent.

The 1918 grease content of garbage, its richness, averaged 18% less than in 1917; compared with 1916, the richness of 1918 garbage showed a reduction of about 25 per cent.

The total volume of garbage grease recovered showed a reduction of 28% from 1917 recoveries. As 1917 recoveries exceeded those of 1916 by 13%, the 1918 reduction was only 19% less than in 1916.

Changes to feeding during the year totalled 40, some of them being cities of over 10,000 population; changes to reduction totalled 3.

The amount of garbage still wasted is sufficient to produce more than 30,000,000 lb. of garbage grease, 60,000 tons of fertilizer tankage and 40,000,000 lb. of pork.

FROM a popular point of view, garbage might well be considered as a war-time discovery; something which had no existence in pre-war times. While considerable technical literature on the subject is available, and engineering journals have devoted considerable space to the garbage problem, the general public seemingly remained in ignorance that such a thing as garbage existed; probably, more correctly speaking, the general public was exceedingly indifferent to the subject; the word was in ill repute and the "garbage business" considered as all but illicit.

High prices, the shortage of food and the patriotic response to the need of war-time conservation all combined to focus attention on the garbage pail, and brought about a remarkable change in the attitude with which garbage was regarded. Archaic "sanitary regulations" prohibiting anything but the burning of this waste were set aside almost over night; others were changed to eliminate certain portions which had prevented the utilization of the waste to best advantage; the housewife recognized garbage as a necessary evil, and cut down in every way possible the material finding its way into the garbage pail, while cities having low per capita productions congratulated themselves. On the other hand, many fantastical schemes for recovering the values in garbage were set forward, and a number of failures are to be noted because of the lack of observance of even the fundamental principles underlying its utilization.

The housewife seemingly decided to solve the garbage problem once for all by eliminating garbage. She unquestionably cut down materially not only the volume of her kitchen and table refuse, but even further reduced its meat and fat content.

While elimination of garbage is undoubtedly the ideal solution of the problem this waste represents, even the best efforts of the housewife failed, and they will continue to fail until such time as the nature of our ordinary foodstuffs undergoes considerable change. Great reductions have been claimed by some cities; in fact, claims of entire elimination for considerable communities are not unknown, and any number of cities where mixed or combined collection prevails have reported their respective communities producing so little garbage as to make segregation useless. In cities having separate collection of garbage, the authorities, and even the contractors for disposal, claim as high as 50% decrease in volume. Investigation in such cases almost invariably discloses a large portion of the garbage finding some other outlet.

The plea for conservation of paper, rags, etc., has had a decided effect in cities maintaining a separate collection of such wastes. It is reasonable to suppose that this same decrease has occurred probably in all cities, and that any great reduction with single collection of all wastes is made up partly by lessened quantities of household wastes other than garbage. The high prices of byproducts have also encouraged private collectors to extend their operations, and there are very few cities which do not report that at least a part of their garbage is utilized.

The campaign for food conservation did not gain full force until late in the summer of 1917, and the first year of garbage collections under war conditions may be said to have ended with April, 1918. The year 1916, while possibly not normal because of high prices, did not have the patriotic stimulus condemning wastefulness, nor was an organized effort made to increase exports to the allies. Table I, based on data compiled by the Statistical Division of the Food Administration, shows in part that for a number of cities, and a combined population of over 26,000,000, the reduction for the year which ended April, 1918, over that for the previous year, averages 10 per cent.; the per capita figure is 17 lb. less than for the previous year. For June to October, inclusive, the summer season when garbage production is at a maximum, 1917 collections show a reduction of about 9% under 1916, 1918 shows about 10% less collected than during 1917, while a comparison of the summer season of 1918 with that of 1916 shows a decline of 22½% in collections.

The data given in Table I include reports from a number of cities known to be using a mixed collection system. It is not known how the garbage content of

TABLE I. WAR-TIME REDUCTIONS IN THE AMOUNT OF GARBAGE COLLECTED FOR A NUMBER OF THE LARGER CITIES OF THE UNITED STATES

Month	Number and Population of Cities Reporting: 1917 Number (2)	1917 Population (3)	1918 Number (4)	1918 Population (5)	Tons of Garbage Collected: From Population in Col. No. 3: 1916 (6)	1917 (7)	From Population in Col. No. 5: 1917 (8)	1918 (9)	Relative Amount Collected during the first year named, collection during that last named being taken as equal to 100: 1917 to 1916 (10)	1918 to 1917 (11)	1918 to 1916 (12)	Per Capita Production (Given in pounds per capita per year): 1916 (13)	1917 (14)	1917 (15)	1918 (16)
Jan.			83	21,302,026	.....	.....	182,048	143,841		79		.....	.....	205	162
Feb.			76	19,559,589	.....	.....	163,975	128,327		89		.....	.....	177	128
Mar.			77	20,243,103	.....	.....	154,799	154,486		100		.....	.....	183	184
Apr.			86	23,975,056	.....	.....	171,437	175,495		104		.....	.....	171	176
May.			72	21,123,545	.....	.....	148,115	153,667		104		.....	.....	169	175
June	34	17,014,273	82	22,785,713	156,060	143,000	188,043	179,771	92	96	86	220	202	198	189
July	59	21,152,943	67	21,132,451	217,816	193,357	198,939	183,315	89	91	89	247	220	328	219
Aug.	69	21,792,365	69	20,276,331	243,771	225,927	192,727	174,057	93	90	77	268	249	228	206
Sept.	81	22,942,009	72	22,415,121	251,009	225,045	204,569	176,959	90	86	72	263	236	219	189
Oct.	83	22,365,024	74	22,764,743	224,893	208,742	198,241	169,074	92	85	74	242	224	210	178
Nov.	82	22,964,069			212,296	190,161			89			222	199		
Dec.	78	22,371,922			190,280	165,910			87			204	178		
Total for year ending with April				26,034,685			2,609,134	2,388,932		90.2				200	181
Total for year ending with October				21,659,473			2,185,469	1,995,063		91.3				202	184
Total for period June to October, inclusive	21,053,323		21,674,872		1,093,547	996,072	982,519	883,176	91.1	90.0	78.5	249	228	218	197

NOTES—Due to failure to receive reports, evident errors, etc., the total population reporting has changed each month. The per capita figures given for 1916 (Col. No. 13) and in the first of the two columns headed 1917 (Col. No. 14) have been determined by using the population reporting during 1917 (Col. No. 3); those for 1918 (Col. No. 16) and in the last of the two columns headed 1917 (Col. No. 15) are based on the population reporting during 1918 (Col. No. 5).

For purposes of comparison with annual per capita productions, the figures given in columns Nos. 13, 14, 15 and 16 are the monthly per capita figures (production in pounds divided by population) multiplied by 12.

The relative amounts given in columns Nos. 10 and 11 have been determined by the equation—production in last year named is to production in first year named as 100 is to x. The relative amounts given in column No. 12 have been determined by multiplying the 1916 production by the 1918 population and the 1918 production by the 1916 population and applying the above equation.

such mixed collections was obtained, and it is doubtful, from the per capita figures reported, whether any attempt has been made even to estimate the garbage content of the total material collected. The data collected by the Statistical Division again emphasize the lack of uniformity in waste-production records.

The detailed figures on which Table I depend show 81 cities with reduced collections. The four showing the greatest percentage of reduction either collect combined wastes, or the validity of their records is questionable. Buffalo, N. Y., stands fifth on the list with a reduction of 29 per cent.; Chicago is 14th with a 25% reduction; Boston and Detroit show a 12% reduction. The remainder of the larger cities show reductions of less than 10 per cent. Of the cities showing a reduction of over 25 per cent., six collect garbage and their household wastes combined, or have poorly organized collection systems. The remaining seven cities are believed to have reasonably accurate figures, the reductions being 40, 33, 29 (4 cities) and 26 per cent.

Table II shows detail figures, covering the same periods as Table I, for certain larger cities separately collecting this garbage. It is rather significant that the relative figure of this table is 93.1, denoting a reduction of less than 7%, whereas Table I shows almost 10 per cent. This seems to bear out the idea that large reductions reported are due to decrease in wastes other than garbage.

Buffalo, which had a high percentage reduction, is omitted. The per capita figures for this city show 93 lb. for 1916-1917 and but 66 lb. for 1917-1918. It is felt that this per capita production is so low as to indicate that a large part of the garbage found some other outlet and was not reported with the city figures. Chicago and St. Louis have also been omitted. The data for St. Louis show a reduction of about 13%, the per capita figures being 98 and 85 lb., respectively. Private collectors operate in St. Louis to no inconsiderable extent; their operations increased materially with the increase in the price of pork, and have so reduced the amount of garbage handled at the reduction plant as to compel the operating company to advise the city of its intention to close the plant.

The omitted data on Chicago are very illustrative of the danger of reliance on per capita figures. The city reports show a tonnage of 124,496 in 1916-1917 and 93,235 in 1917-18. On a per capita basis this gives 100 lb. and 75 lb., respectively. While Chicago has always been credited with having a low per capita production, the figures used in such cases have invariably been based on the amount of material being collected by the city. As a matter of fact, these figures represent only such material as finds its way to the municipal garbage

TABLE II. GARBAGE COLLECTED DURING YEAR ENDING APRIL, 1918, COMPARED WITH COLLECTIONS FOR YEAR ENDING APRIL, 1917

City	Population	Tons Garbage: 1916-1917	1917-1918	Pounds Per Capita: 1916-1917	1917-1918	1917-18 Collections Compared with 1916-17, the Latter Taken as 100
Baltimore	593,000	37,915	24,685	128	117	91.5
Boston	781,628	52,650	46,335	135	118	88.0
Bridgeport	172,113	19,897	18,166	231	211	91.3
Cincinnati	416,300	40,692	34,103	195	164	83.8
Cleveland	674,073	59,708	55,466	177	164	92.9
Columbus, O.	220,000	20,393	17,295	185	157	84.8
Dayton	155,000	16,621	15,677	214	202	94.3
Detroit	750,000	72,785	64,270	194	172	88.3
Grand Rapids	140,000	8,678	7,359	124	105	84.8
Indianapolis	271,758	23,267	19,929	171	147	85.6
Los Angeles	600,000	51,062	47,345	170	158	92.7
New Bedford	118,158	10,162	8,774	172	148	86.3
New York	5,377,456	487,451	445,237	182	166	91.3
Philadelphia	1,709,518	101,678	114,160	119	134	112.3
Pittsburgh	579,090	73,758	72,612	255	251	98.4
Rochester	275,000	30,782	25,926	224	189	84.2
Toledo	220,000	23,971	22,180	218	201	92.5
Washington	400,000	46,293	46,732	232	234	100.9
Total	13,453,094	1,177,763	1,096,251	175	163	93.1
Total of 96 cities (from Table No. I)	26,034,685	2,609,134	2,388,932	200	183	90.2

plant, and practically no hotel, restaurant or lunchroom garbage is included. Reports from private collectors in Chicago show at least an additional 40,000 tons privately reduced during the year which ended last April. This alone is sufficient to increase the per capita figure from 75 to more than 100 lb. Even these figures do not take into account the amount of garbage hauled from the city and used for hog feeding, neither is included such garbage as is burned, an investigation of garbage collections in Chicago indicating that last July a population of over 300,000 was disposing in privately owned incinerators of its kitchen and table refuse.

Table III gives in detail collections during 1916, 1917 and 1918 for New York, Chicago, Detroit, Columbus and 16 of our larger cities having separate collection of garbage. The severe weather conditions of last winter show their influence on the amount of garbage collected and are the cause of some fluctuation in per capita figures. The surprisingly low figure for Chicago in a conservation effort lies in the reduction of the grease content of the garbage rather than in its volume. Many of our vegetable foods contain a considerable percentage of material not at all suitable for human consumption when purchased. This must necessarily find its way into the garbage pail, and a season of cheap vegetables may increase garbage production even when conservation has been most carefully observed.

The data accumulated for the fertilizer administration include a very complete record of garbage grease recovery during several years past. These data, however, were obtained under Congressional authority, and detailed information cannot be made available. Such restrictions, however, do not apply to totals of production, etc. Table IV has been made up from this record and gives data for five municipal plants and for all plants handling garbage, whether municipal or privately owned. These comprise about 70 plants, in varying degrees of efficiency.

TABLE III. COMPARISONS OF GARBAGE COLLECTED IN 1916, 1917 AND 1918 SEPARATELY FOR FOUR CITIES AND COMBINED FOR SIXTEEN CITIES

	New York (Population, 5,377,454)			Chicago (Population, 2,497,722)			Detroit (Population 750,000)			Columbus (Population, 220,000)			Total of 16 Large Cities, (Combined Population, 13,181,000)		
	1916	1917	1918	1916	1917	1918	1916	1917	1918	1916	1917	1918	1916	1917	1918
January	33,100	32,975	24,935	9,757	7,897	2,388	5,859	5,816	3,947	1,569	1,365	1,058		81,850	63,579
February	29,800	26,399	22,350	8,063	5,904	4,347	5,123	4,756	3,734	1,475	1,019	1,062		70,418	59,992
March	31,980	29,995	29,283	8,585	5,936	6,051	5,549	4,860	4,408	1,502	1,040	1,328		70,627	73,805
April	34,600	31,692	33,650	9,310	6,182	6,222	5,735	4,802	4,373	1,566	1,219	1,317		74,861	78,127
May	45,350	36,602	37,422	11,177	2,990	7,434	6,572	5,357	4,888	1,910	1,177	1,389		82,286	86,558
June	48,099	44,628	39,800	12,826	8,386	8,374	6,595	5,733	5,809	1,865	1,262	1,212	113,296	103,952	89,033
July	52,173	49,295	41,550	14,302	11,239	9,503	6,407	6,318	6,319	2,388	1,674	1,356	122,782	111,523	98,355
August	53,368	51,545	41,209	16,093	12,583	10,079	7,032	6,636	6,969	2,690	2,176	1,696	133,314	121,073	106,290
September	48,934	45,903	37,422	14,774	12,142	9,268	7,222	6,786	6,686	2,285	2,123	1,509	127,643	115,583	97,418
October	44,639	42,786	32,835	12,462	11,259	8,141	6,635	6,608	7,004	1,900	1,778	1,291	117,382	110,873	92,584
November	39,299	35,551		9,663	8,967	6,882	5,796	6,042	6,328	1,476	1,287	1,236	103,163	92,456	81,008
December	34,691	28,739		7,280	6,661	6,285	5,907	4,996		1,236	1,052	1,176	92,449	83,980	
Total	496,033	456,110	a400,456	134,292	100,146	84,974	74,432	68,710	b65,465	21,862	17,172	15,630	c810,529	1,119,482	d926,749
PER CAPITA PRODUCTION, BY MONTHS (In Terms of Pounds per Capita per Year (Production per capita per given month multiplied by 12)															
January	148	147	111	94	76	23	188	186	126	171	149	115		149	116
February	133	118	99	78	57	42	164	152	119	161	111	116		128	109
March	143	134	131	82	57	58	177	156	141	164	113	145		129	134
April	155	142	150	89	59	60	180	154	140	171	133	144		136	142
May	201	163	167	107	29	71	210	172	156	208	128	151		150	158
June	214	199	178	123	80	80	211	183	183	204	138	132	208	189	162
July	233	220	186	137	108	91	205	202	202	261	183	148	224	203	179
August	238	230	184	154	121	96	225	212	223	294	237	185	243	221	194
September	218	205	167	142	117	89	231	217	214	249	232	164	232	210	177
October	199	191	146	120	108	78	212	211	224	207	194	141	214	202	168
November	175	159		93	86	66	186	193	202	161	140	135	188	168	148
December	155	128		70	64	60	189	160		135	115	128	168	153	
Average	185	170	a149	108	80	68	198	183	b174	199	156	142	e211	170	d154
RELATIVE AMOUNTS OF GARBAGE COLLECTED (that of the year last given being taken as 100)															
	1917 to 1916	1918 to 1917	1918 to 1916	1917 to 1916	1918 to 1917	1918 to 1916	1917 to 1916	1918 to 1917	1918 to 1916	1917 to 1916	1918 to 1917	1918 to 1916	1917 to 1916	1918 to 1917	1918 to 1916
January	100	75	75	81	30	23	99	68	47	87	78	67		78	
February	89	85	75	73	74	54	93	78	73	69		72		85	
March	94	98	92	69	102	71	88	91	79	69		88		104	
April	92	106	97	66	101	67	84	91	76	78		84		104	
May	81	102	82	27	249		82	91	74	62		73		105	
June	93	89	83	65	100	65	87	101	88	68	96	65	91	86	78
July	94	84	80	79	85	66	92	100	92	70	81	57	91	88	80
August	96	80	77	78	80	62	94	107	99	81	78	63	91	88	80
September	94	81	76	82	76	63	94	98	93	93	71	66	91	89	76
October	91	77	74	90	72	65	100	106	106	93	73	68	94	83	79
November	90			93	77	71	104	105	109	87	96	84	89	88	78
December	83			92	94	86	85			85	90	95	91		
Average	92	a88	a81	75	85	63	92	b95	b88	78	91	72			

a November and December estimated. b December estimated. c Total for seven months. d Total for eleven months.

May, 1917, is due to labor trouble at the plant, it having been necessary to dump a large part of the material collected during that month.

For convenience in comparing with annual figures, the monthly per capita figures in each of the tables have been given in terms of pounds per annum. The actual per month production can be obtained by dividing the given figure by 12.

It has long been recognized that the true measure of

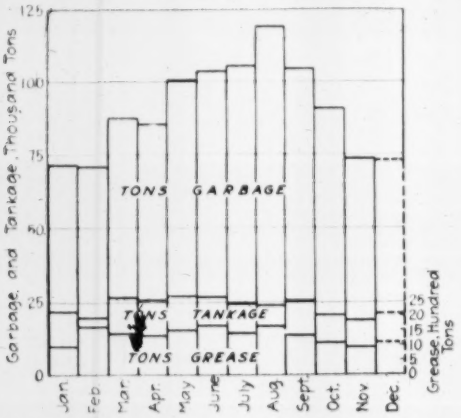
It will be noted from Table IV (see next page) that in both instances the amount of garbage treated during 1917 is greater than that handled during either 1916 or 1918. The amount of grease recovered decreased each year in the case of the municipal plants, while the total recovered by all plants was greatest in 1917. In spite of this increase in grease recovery, the yield per ton of garbage was less in 1917 than in 1916, the richness of the garbage decreasing each year. The average recovery per

TABLE IV.—GARBAGE REDUCED, GREASE RECOVERED AND TANKAGE MADE—1916, 1917 AND 1918

	Total of Five Municipal Reduction Plants			Total of All Municipal and Private Reduction Plants	
	1916	1917	1918	1916	1917
Tons garbage disposed of	177,555	194,514	178,302	1,026,764	1,275,447
Pounds grease recovered	9,550,390	8,561,454	7,348,131	69,051,340	78,127,027
Tons tankage produced	41,101	42,502	25,382	129,790	167,569
Pounds grease recovered per ton garbage	54	44	41	67	61
Pounds tankage recovered per ton garbage	464	334	284	253	262
Relative figures, 10 as base	1917 to 1916	1918 to 1917	1918 to 1916	1917 to 1916	1918 to 1917
Grease recovered	90	86	76	113	72
Grease per ton	81	93	76	91	82
Tankage recovered	79	78	62	129	95
Tankage per ton garbage	72	85	61	103	109

ton of garbage for all plants exceeds the recovery of the municipal plants alone. This is doubtless occasioned by the fact that the total figures include returns from plants handling only the better grades of garbage, plants in which the grease content runs as high as 8 and 10 per cent.

Relatively, the grease recovery per ton, or the richness of the garbage, shows a somewhat small drop. Comparing 1917 with 1916 this decrease equals 19% for the



GARBAGE REDUCED AND PRODUCTS RECOVERED IN 1918

municipal plants and but 9% for all plants. On a two-year basis—that is, comparing 1918 with 1916—the drop in richness is more pronounced, being 24% and 25% respectively.

For the municipal plants the relative volume of grease recovered is only 10% less in 1917 than in 1916, as against 19% decrease in richness. For all plants an increase is noted. On the two-year basis, 1918 compared with 1916, the decrease in volume recovered corresponds very closely with the decrease in richness, being equal (24%) for municipal plants, and 19%, as against 25% in richness, for the total of all plants.

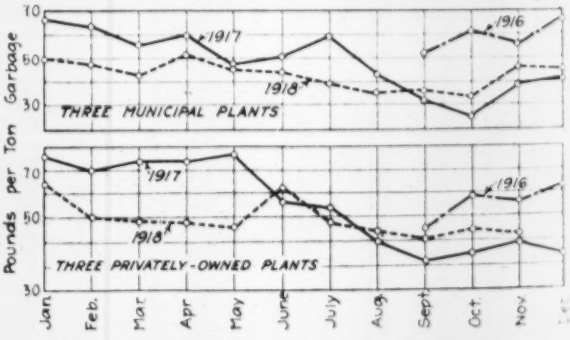
The figures for tankage recovery show surprising variation. The decrease in tankage per ton of garbage shown for the municipal plants can only be accounted for by the garbage having a greater percentage of moisture. This need not necessarily mean that a wetter garbage is being delivered, as an increase in the percentage of green material would naturally increase the moisture content and have the effect of decreasing the tankage yield. It will be noted that the volume of tankage recovered per ton of garbage is very high.

The rather low average tankage yield per ton of garbage for all plants is due to the poor recovery systems in effect at a number of such plants, and to the fact that in some instances tankage was fed to hogs while in a wet state or even pressed and used as fuel. As tankage became more valuable less wastage occurred, and it is to be noticed that the recovery increased each year.

In comparing recoveries during the periods which ended April, 1917, and 1918, collection data for which are covered in Tables I and II, the average grease recovery at five privately owned plants shows 50 lb. for the year which ended April, 1917, and but 37 lb. for the year which ended April, 1918. The reduction in richness equals 16% and the reduction in volume 17 per cent. For corresponding periods the average yield for the municipal plants at Chicago, Cleveland and Columbus was 52 lb. for the year which ended April, 1917, and 41 lb. for that which ended April, 1918. This is a reduction in richness of 21 per cent., the corresponding reduction in volume being 36 per cent. The fact that the richness in each case is higher for the municipal plants is rather surprising, each of the five privately owned plants considered having equipment equal to that of the three municipal plants named. It is believed that this difference can be accounted for by the fact that the municipal plants in every case actually weigh the material received, while in several of the privately owned plants which are considered the material treated is estimated.

A diagram shows the average grease yield per ton of garbage for three privately and three municipally owned plants. It will be noticed that in both cases the curve for 1918 begins well below that for 1917, and that the two gradually approach and finally cross. Even the last points of the 1918 curve, however, are considerably below the values for 1916.

While the curves of total production for each of these combinations of plants would show a decided break during the poor weather of last January, it is to be noticed that the January yield shows a considerable increase over that for December, 1917. The cause of this increase is probably due to bad weather, which



AVERAGE GARBAGE GREASE RECOVERY 1916-18

The three municipally owned plants at Chicago, Cleveland and Columbus are compared with three well managed privately owned plants.

caused less interference with collections in the downtown district, where richer garbage is produced, than in the outlying districts.

Curves covering the monthly tonnage reduced, the total tons of grease recovered, and tons of fertilizer tankage produced, are also given. (See diagram at the top of the next page.) Each of these curves properly ends with November, for, while blanks covering December's operations were sent out to all plants, no special effort was made to see that these were returned, and a number are still missing. The quantities handled and produced at such missing plants have been estimated and December quantities established. Such estimated quantities total 30,000 tons of garbage, 848 tons of grease and 3900 tons of tankage.

The general tendency toward conservation in food, fuel, metals, paper and other everyday commodities naturally makes the overwhelming tendency to utilize this so-called waste an outstanding feature of the year's changes in garbage disposal. Information received from various city officials indicates that no less than 40 cities of over 10,000 population have changed from some nonutilization method of garbage disposal to feeding of swine. The combined population of these 40 cities totals over 2,000,000, and their location ranges from California to New York.

In almost every instance where changes have occurred, disposal is being conducted under contract rather than by municipal forces. In one or two instances, municipal hog farms have been established, and in other cases the city has a number of feeders hauling the material collected, from some convenient central point, at a stipulated price per ton.

The year's changes from nonutilization methods to the reduction process for recovery of grease and fertilizer tankage total three, with a combined population of about 250,000. In each instance the plant established is being operated as a private enterprise.

Changes from utilization methods to nonutilization systems likewise number three, but in two of these instances the present method is due to financial difficulties, fire, etc., and these cities will very shortly be numbered among those utilizing.

The accompanying Table V gives a list of cities reporting to the Food Administration as having changed their system of garbage disposal to one of utilization. While the reported returns are official, it must be remembered that the city authorities reporting have been urged by the Food Administration to adopt utilization. It is consequently believed that in a number of instances only a portion of the garbage actually produced is being utilized. A start has been made, however, and these cities have committed themselves to a utilization method of disposal.

In addition to the tangible results indicated by the table just mentioned, there are, as further evidences of progress in garbage utilization, certain developments which should mean decreased garbage wastage during the coming year. Syracuse, N. Y., and New Orleans, La., have had garbage reduction plants authorized, and at Syracuse the plant is in process of construction; San Francisco, Cal., opened bids contemplating utilization on Jan. 20, one bid of $1.26 per ton having been obtained; Wheeling, W. Va., recently entered into contract for disposal by feeding; Norfolk, Va., Newark, N. J., and a number of other cities are considering propositions submitted to them by various corporations planning for disposal by feeding. In fact, a number of the replies being received by the Food Administration from cities not utilizing are very apologetic in tone. In a number of such cities it is reported that the garbage produced by hotels and larger institutions is being hauled away by farmers who have become interested in garbage feeding.

The amount of garbage still available for utilization is enormous, and the possibilities of further utilization of garbage include the following:

1. Due to poor separation, incineration, etc., in cities having reduction plants available, it is estimated that there are being wasted per annum 6,000,000 lb. of grease and 15,000 tons of fertilizer tankage.

2. Some 20 cities of over 100,000 population, and therefore large enough to support a reduction plant, are not utilizing their garbage. Their combined population exceeds 5,000,000, and it is estimated that 30,000,000 lb. of grease and 60,000 tons of fertilizer tankage are lost per annum. These cities, in addition, also destroy large amounts of paper, rags, etc., readily salvable.

3. The poor separation, etc., already mentioned affect the efficiency of garbage feeding farms to even a greater extent. Poor methods of handling are also very prevalent. Pork production could be increased approximately 100% by better handling in the household and on the farms.

4. Some 300 cities of between 10,000 and 100,000 population and totalling over 5,000,000 in population are wasting sufficient garbage to produce from 30,000,000 to 40,000,000 lb. of pork every year. In many instances these cities are also using fuel for disposal and wasting valuable waste paper, rags and other readily salable materials.

The year's changes from nonutilization methods mean that from 15,000,000 to 20,000,000 lb. of pork per annum will be produced from garbage formerly wasted. The changes to reduction should increase our garbage-grease production about 1,500,000 lb. per annum and our fertilizer tankage production about 3500 tons. It must be remembered that the addition of this amount of pork, grease and fertilizer will be accomplished without the use of any of our existing fats or other commercial commodities. They represent recoveries from a material formerly regarded as worthless, and wasted.

Whether the present attitude toward garbage wastage will continue, or whether the setting aside of war-time restrictions will mean a return to the old standard of

TABLE V. CITIES HAVING CHANGED FROM A NONUTILIZATION METHOD OF GARBAGE DISPOSAL DURING 1918

CHANGES TO FEEDING

Cal.	Alameda	Iowa	Des Moines	N. Y.	Oneonta
	Santa Cruz		Mason City	N. Car.	Wilmington
	Santa Jose	Kans.	Leavenworth	Ohio	Coshocton
Ill.	Bloomington	Ky.	Covington		Lima
	Cairo		Louisville	Ore.	Portland
	Moline	Mich.	Holland	Penn.	Altoona
	Peoria		Kalamazoo		Coatesville
	Rock Island		Owosso		Easton
	Rockford	Minn.	Brainard		Lebanon
	Springfield		Minneapolis	Utah	Salt Lake City
Ind.	Goshen	Miss.	Jackson	Wis.	La Crosse
	Logansport	Mont.	Great Falls		Madison
	South Bend	N. Y.	Cortland	W. Va.	Fairmont
			N. Tonawanda		

CHANGES TO REDUCTION

Fort Wayne, Ind.; Dubuque, Iowa; Reading, Pa.

quantity and quality of garbage, depends largely on how strongly the spirit of economy and conservation has impressed itself on the public mind. The general feeling throughout the Food Administration seems to be that at least a part of the lesson that has been learned will be slow in wearing off.

Probably the low level in garbage production has been reached, grease content certainly seems to have reached a level, and any further reports on the subject of utilization should show an upward trend of both production and grease curves.

The desire to utilize all possible materials will unquestionably carry beyond the present campaign for conservation. Far more is known of the values contained in so-called waste products than before the war. Probably no inconsiderable factor, as affects garbage utilization, will be the organizations now caring for the garbage accumulating at Army camps, practically all of which is utilized. As such camps are abandoned it is believed that the men interested in these ventures will turn their attention to obtaining the garbage produced in our cities. The number still not utilizing should promise them a ready opportunity to continue along the present line of their endeavors, and the coming year should show an even greater advance in garbage utilization than 1918 has shown.

Shallow Brick Stand Up Well On Cement-Sand Base

Patching Brick on Ramps of Pennsylvania Station, New York, Shows Them to Be Worn Nearly Through Without Breaking

THE capacity of shallow vitrified brick for standing up under heavy traffic, when laid upon a cement-sand bed, is exemplified in the ramps of the Pennsylvania Station at New York, where sections eight years old were recently replaced. Investigation showed that in places the brick had worn more than half through without the top surface being shattered, although sustaining a traffic uncommonly heavy, as shown by census. The construction of these drives was noted in *Engineering Record* of Oct. 9, 1915, p. 456, and a traffic census of them in the issue of July 8, 1916, p. 54. Following is a brief description of the original construction and the replacement that has been made.

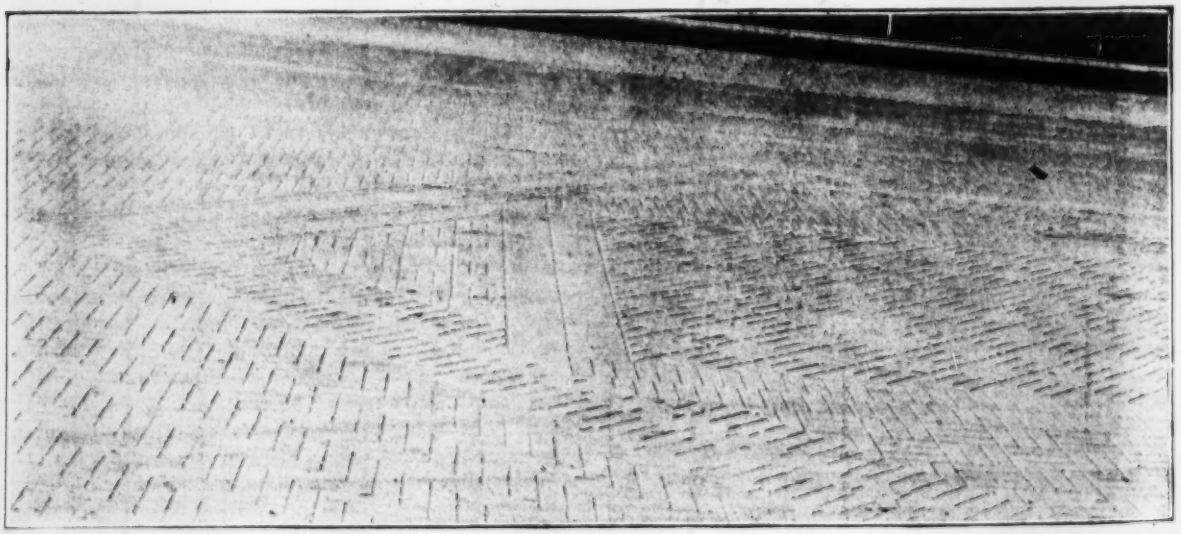
These ramps are the first pavements of any note laid in the monolithic or semi-monolithic type of construction. There had been isolated cases where brick had been laid in this manner, but there had generally been some features, such as subsequent covering with bituminous material, which made it difficult to determine the value of the construction. The ramps were laid in 1910, and when in 1914 or 1915 a controversy arose over monolithic construction, they were extensively cited as an example by those favoring that type.

To the present time there has been no information, except hearsay, as to the method of construction of these ramps, and those who favored the sand-cushion type of brick construction have expressed doubt as to the manner of laying. Now, however, the pavement having been opened, a complete description can be given.

The foundation of the pavements is of concrete and is tied in with the rest of the station. Upon this about 1 in. of cement and sand, mixed in the proportions of 1:3 and slightly moistened, was spread to form a bed for the brick. Clearfield fire-clay brick were used for the work, and were made in a special shape, being 7½ x 2¾ in., 2½ in. in depth. They were made without lugs, and all four surface corners were chamfered to give a hillside effect upon the grades and bring out the artistic figures in which they were laid.

Upon the cement-sand bed, the brick were laid "herring-bone" by hand, each block being bedded with a hammer to the proper elevation. A view of one of the ramps, showing the figures designed by the architect, is shown. In laying the brick care was taken to give spacing to allow for the penetration of the grout filler.

Heretofore it was supposed that the filler consisted of portland cement and fine sand, mixed in the proportions of 1:1, but examination of samples indicates that it was



BRICK WITH BEVELED EDGES LAID IN FIGURES TO GIVE ARCHITECTURAL EFFECTS

grouted with neat cement. This conclusion is also verified by statements of the contractor who did the original work and who has made the repairs. Even with the care taken to space the blocks and the use of pure cement filler, there were many joints where the grout did not penetrate to the bottom. While the pavement was not worn through or shattered, with the exception of a few small spots, it was necessary to replace the brick at the entrance recently, on account of the repaving of 7th Ave., which necessitated a slight change in grade.

The driveways have been subjected to a tremendous traffic since being laid in 1910. The traffic census referred to above, taken in 1916, showed that 4,492 vehicles passed over the 33rd St. ramp in an average 24-hour period, while 3384 passed over the 31st St.

NEW BRICK PLACED UPON SMOOTH SURFACE OF OLD PAVEMENT SHOWS EXTENT OF WEAR

ramp. This traffic, in approaching the grade at high speed and setting the brakes, had gradually worn into the brick, as shown in the accompanying photograph, where a full-sized brick is placed on the unbroken surface. This wear was further increased by the use of sand and other means to overcome slipperiness after

NEW WORK MATCHES UP WELL WITH OLD SURFACE

the hillside effect had worn off. Examination of some of the brick which had been removed indicated that in some places even greater wear had occurred without shattering the brick. The surface at the point photographed was in excellent condition. The contention of

WHERE BRICK CONNECTED WITH NEW STREET GRADE EXTRA BED WAS NECESSARY

some that much thinner brick than is customary might be used upon monolithic and semi-monolithic types of construction is thought to be justified by the condition of these drives.

The recent replacement has been done in the same manner as the original work, but the brick are of a different make and are a deeper buff in color. The joint made with the old paving is shown in an illustration. Traffic was allowed on this surface three days after grouting, without any apparent injury, a specification which would have been considered very dangerous with the old sand-cushion type, most specifications requiring from 10 to 15 days, even with the new type.

Another view shows the extra cement-sand bed required to bring the driveways up to the new street grade. Unequal depths of sand bed were also thought dangerous in the old construction.

The work was done under the supervision of the Pennsylvania R. R. engineers, John C. Hendrickson, of New York, being the contractor for both the recent and the original construction.

Wisconsin Highway Engineer Reports Progress

A. R. Hirst, state highway engineer of Wisconsin, reports that the last quarter of last year was the best quarter in the amount of highway improvement completed. This has been accomplished in spite of the fact that on Aug. 5 the United States Highways Council totally deprived highway construction of the principal materials used, such as cement and steel, except where priority orders had been approved. The commission had already cut down the amount of work to be done to about 40% of that previously contemplated. The total amount of construction for 1918, exclusive of Federal-aid projects, is estimated as follows: Grading, 640 miles; crushed-stone road, 110 miles; gravel road, 175 miles; concrete road, 38 miles; shale road, 25 miles; miscellaneous, 15 miles; a total of 1003 miles. Total state-aid expenditures are estimated at $2,400,000. The Federal-aid projects under construction, either by contract or day labor, total 87.36 miles, at an estimated cost of $788,300. These are in various stages of completion. Maintenance work under the new patrol system established last year has been proving very successful.

Omaha Track-Elevation Bridges Vary in Type to Meet Local Conditions

City Requirements and Topography Influence Designs—Steel and Concrete Spans Used, Some With Temporary Floors—Precast Concrete Drains on Ballasted Decks—Steel Girders Have Concrete Facing

FOUR types of bridge superstructure and different types of permanent and temporary bridge floors are included in a short stretch of track elevation on the Missouri Pacific R.R. at Omaha, Neb. This unusual variety and combination were necessitated mainly by the action of the city in making certain controlling requirements, through its engineering department. A sidehill location also introduced conditions influencing the design.

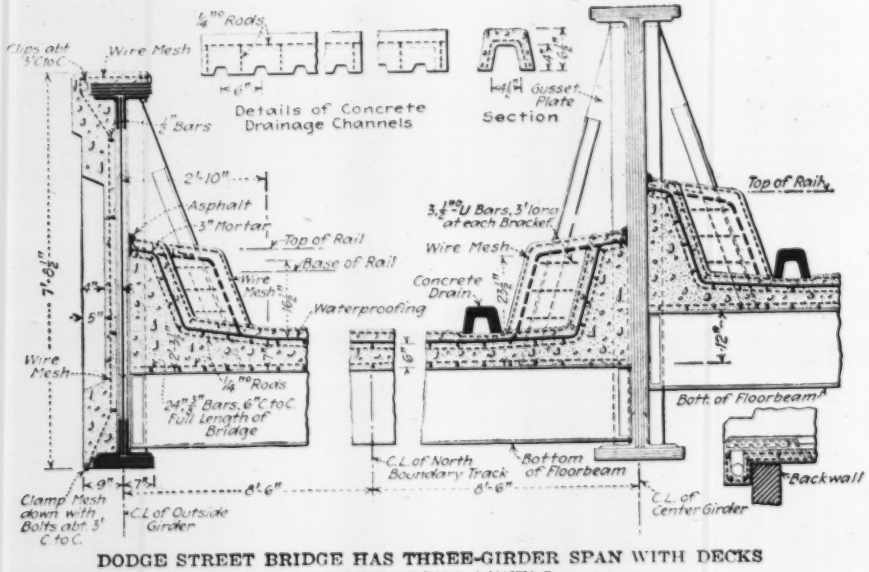
Of the three structures now built one is a steel single-span three-girder through bridge; the second is a steel single-span two-girder through bridge; the third is a three-span deck bridge having an I-beam central span flanked by concrete slab sidewalk spans. For the sake of appearance, paneled concrete facing is used on the outer or street sides of the steel girders of the first two bridges, while the third has concrete fascia girders. Ballasted decks are provided for in all cases, but, as the track elevation is to be extended later, two of the bridges have temporary, shallow, unballasted floors to provide for the grade of the present run-off inclines.

Alternative projects for elevation of the tracks and elevation of the streets were considered in the earlier stages of this problem for eliminating grade crossings, the latter plan being adopted as preferable when several streets were involved. On the west side of the city the Missouri Pacific R.R. crosses Dodge St., a main thoroughfare with a street-car line. About 10 years ago the city passed an ordinance requiring the company to build a viaduct to carry the highway and car tracks over the railroad. As the entire expense, including property damages was to be placed on the company, and as the existing grade crossing was to be left open after the construction of the viaduct, the company made objection. The matter was carried through the courts until in 1915 the United States Supreme Court gave a decision in favor of the city.

A demand for grade separation at adjacent streets had arisen in the meantime, however, and in view of this development an agreement was reached in 1916. This covered the elevation of the tracks for a distance including three streets, the elevation to be extended later as might be necessary. The cost of the work, as estimated at that time, while greater than that of the proposed viaduct for Dodge St., was less than the cost of viaducts at all three streets, which latter arrangement was undesirable from the city's standpoint. All expense had to be borne by the railroad in any case.

Conditions as to span and type of bridges were imposed by the city authorities in its approval of this new project, and several plans were submitted by the railroad before designs satisfactory to the city were perfected. Single spans were required in two cases, but intermediate bents were allowed for the third crossing. A headway of 14 ft. was required, this being considered ample for clearance of trolleys on the Dodge St. car line. All bridges are designed for ballasted decks, with E-55 loading and the Schneider formula for impact allowance.

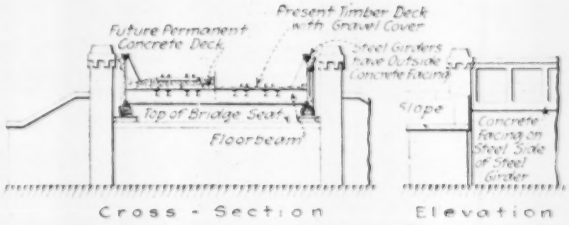
Different levels of parallel tracks were required at the Dodge St. bridge in order to admit of carrying the slope of the street approach on the uphill side halfway under the bridge. This condition led to the adoption of a three-girder type of bridge having two independent decks at different levels. A single span of 69½ ft. between the centers of end bearings provides for a 40-ft. roadway and two 13-ft. sidewalks. The depth of the outer girders is 7 ft. 0½ in., while that of the middle girder is 8 ft. 4½ in. These girders are spaced 17 ft. on centers and have framed between their webs the transverse 18-in. I-beams, spaced 18½ in. on centers, on which the deck slab is laid. This reinforced-concrete deck slab is from 5 to 7 in. thick, covered with a four-ply waterproofing membrane of asphalt and felt, over which is a 3-in. protective layer of 1:3 mortar having wire mesh embedded near the top surface. Form boards were fitted between the top flanges of the I-beams, so that the slab does not extend below the tops of



DODGE STREET BRIDGE HAS THREE-GIRDER SPAN WITH DECKS AT DIFFERENT LEVELS

these beams. Blocks on top of the I-beams support the bottom reinforcing rods. The concrete is carried around the gusset plates, being reinforced here by horizontal stirrups or U-bars. Where the slab extends over the back walls of the abutments it rests on ½-in. zinc plates which permit of longitudinal movement in the expansion and contraction of the deck. The stone ballast is about 8 in. deep under the ties and is filled level with their tops.

In each deck the surface slopes toward a shallow longitudinal gutter near the central girder. In this is a precast concrete drain of inverted trough section, having slots in the edges to form inlets. This is in 6-ft. lengths, the two end lengths being closed at their outer ends. At one end of the deck is a 6-in. elbow in each gutter, opening into a precast concrete transverse drain inclosed in a rib under the end of the deck slab and lying behind the back wall of the abutment. This drain is inclined and has a screw plug at the upper end, to permit cleaning. At its lower end it discharges into a concrete downspout leading to a concrete drain on top of the footing, which in turn leads to a sewer catchbasin. These footing drains are used



FARNAM STREET BRIDGE HAS TEMPORARY TIMBER DECK TO KEEP RAILS AT LOW ELEVATION

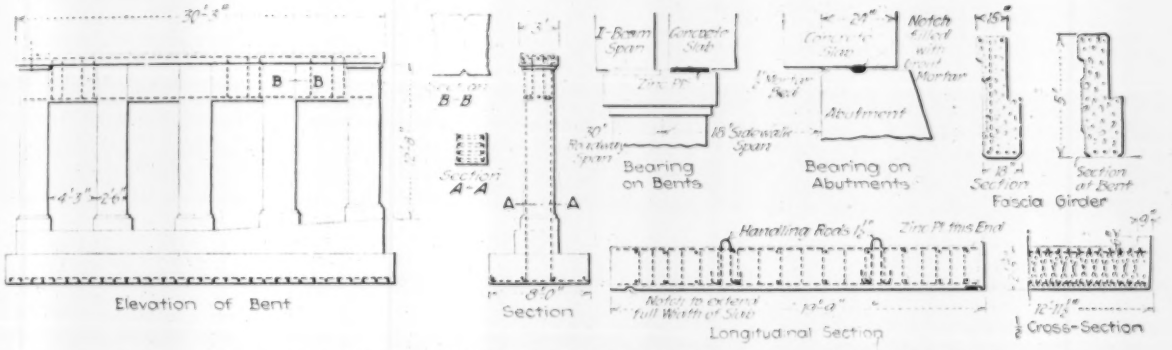
at all the bridges and extend the full length of the abutments and wing walls. They are slotted so as to take seepage coming through the earth fill.

Concrete masking or casing of the girders is for appearance only, and is applied therefore only to the outside of each outer girder. It has a thickness of from 4 to 9 in., and covers the top flange and web stiffeners, but not the bottom flange. The bottom cover plate extends 2 in. beyond the other plates and forms a shelf which supports the concrete and to which the reinforcing mesh is bolted. This mesh is wired to rods carried in holes in the outside web stiffeners. It is secured to the inner edge of the top flange by double-nut bolts, the lower nuts keeping it out of contact with the plates. Clips serve a similar purpose on the outer edge of the top flange.

This masking concrete is a 1:2:3 mix, using a stone up to ¾ in., or sidewalk chips. It was placed in wood forms, and after their removal was finished by rubbing with carborundum bricks.

A single-span through-girder bridge is used also at Farnam St., with plate-girder floor-beams spaced 7 ft. on centers. In this case, however, there are only two girders, and these are almost 77 ft. between centers of end bearings, as the crossing is on a skew. They are 9 ft. 6½ in. deep and are masked with concrete, as described above.

Shallow floor construction of a temporary character is employed here, in order to keep the rail level as low as possible for the inclined run-off at the end of the track elevation. This floor has four 12-in. I-beam stringers under each track, carrying a solid deck of 6-in. transverse timbers to which the rails are spiked. Spaces between the tracks and between tracks and girders are closed with 3-in. plank. The whole deck is covered with No. 20 sheet iron and a 2-in. layer of gravel mastic. At such future time as track elevation may be extended over the next street, Leavenworth St., a concrete deck will be laid on the floor-beams and stringers, carrying ballasted track at normal grade.



DOUGLAS STREET BRIDGE COMBINES I-BEAM AND CONCRETE SLAB SPANS

An entirely different construction is employed for the Douglas St. bridge, as the city permitted the use of curb-line bents. This allowed the use of short spans, and the adoption, largely, of concrete. The bents are of concrete, having square columns spaced 6 ft. 9 in. on centers, supported on continuous footings and carrying cap girders.

For the roadway span, 30 ft. 1 in. between centers of bents, there are under each track four longitudinal 30-in. I-beams, designed to carry a concrete deck slab and ballasted track. At present they are covered with a solid 3-in. plank floor protected against cinders by a metal and mastic covering as at Farnam St. Bridge ties are laid directly on this floor, being secured to the I-beams by hook bolts.

Concrete slabs are used for the two sidewalk spans of 18 ft. 4¾ in. These were cast in place. Each span is composed of two slabs, 20 x 13 ft., 29 in. thick. Each slab is for a single track and has curbs on both sides to retain the ballast, which will be placed when the tracks are raised to grade. At present, bridge ties

are laid on six lines of 2 x 10-in. planks under each track, the planks being held in place by 2 in. of lean concrete filled between them. The ties are secured by bolts passing through outside guard timbers and anchored to the slab.

Expansion movements are provided for by ½-in. zinc plates embedded in the lower faces of the slabs and resting on similar plates in the cap girder of the bent. At the abutment the slab has a key registering with a groove along the top of the bridge seat, which is filled with grout and forms a key or anchor for the fixed end. The slab is made with a 1:2:4 concrete, and the bottom has 2 in. of 1:2 mortar. Its reinforcement consists of top and bottom bars with W-shaped stirrups extending the full width.

A continuous parapet slab or fascia girder of concrete extends the full length of the structure on each side, thus masking the span and deck construction. These girders are 5 ft. deep, with coping and paneled outer face. They rest on zinc sliding plates on both abutments and one bent, being anchored by dowel rods to the cap girder of the other bent.

All Foundations Are Wood Piles

The foundations of all of the bridges consist of wood piles driven to refusal, with a penetration of 20 to 35 ft. in black soil and spongy clay. These carry a load not exceeding 15 tons per pile. The concrete abutment and wing walls are of semi-gravity type, and are made with stone and of 1:2½:5 mix. The footing slabs were built first, with grooves and steel dowel rods in the top to bond with the walls. Reinforcing bars are placed in the bottom of the footings; also in the rear of the abutments and wings and in the back walls of the bridge seats. Expansion joints are made at the connections of the wings with the abutments. At the two steel bridges ornamental posts on the abutments conceal the ends of the girders.

Good appearance of the exposed surfaces of concrete was given by hand rubbing with carborundum blocks as soon as possible after removal of the forms. The part being rubbed was kept wet by sprinkling with a large brush, the rubbing and sprinkling being continued until the form marks disappeared and a film of cement was brought to the surface. This film was smoothed out or grained with a damp brush.

The grading, concrete and part of the track work were done by the List & Gifford Construction Co. The piledriving and steel bridge work, including the erection, the construction of concrete and timber decks and the concrete masking of girders, were done by the forces of the railroad engineering department. The design and the construction of the entire work were in the hands of S. L. Wonson, bridge engineer; W. R. Rhodes, assistant engineer, was in resident charge of construction. All the work was under the direction of A. E. Hadley and H. R. Carpenter, successively chief engineers of the Missouri Pacific R.R. The plans had to be approved by John A. Bruce, city engineer of Omaha.

The total estimated cost of the improvement was about $200,000, of which the cost of the three bridges, with their masonry and foundations, represented $80,000. Double-track fills form the remainder of the work.

Removing Algae from a California Irrigation Canal

Fixed Screens and Copper Sulphate Inadequate—Rotary Screen with Water Jet and Heavier Dose of Agent Used

By E. Court Eaton

Superintendent of the Lindsay-Strathmore Irrigation District, Lindsay, Cal.

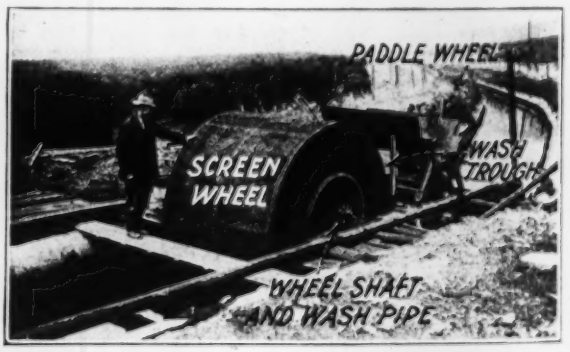
ALGÆ growths caused the Lindsay-Strathmore Irrigation District considerable trouble during the year just past, which was its first irrigation season. A brief description of the nature of these growths, and how they were overcome in large part by the use of screens and copper sulphate, may prove helpful to others.

The entire water-supply, which is obtained from wells, is carried through six miles of canal and six miles of rectangular flume, and then distributed to consumers through riveted steel pipe. All the water is metered. Even a few algæ are not permissible, as they would rapidly clog the meters or get into the consumers' service pipes, thus cutting down the flow through the hydrants and making it impossible to maintain service under uniform pressure.

The canal has a bottom width of 6.3 ft., a depth of 3.5 ft., side slopes of 1 to 1, and is gunite lined. While this is superior to a plastered lining, it has the disadvantage of leaving a rough surface which allows the algæ to grow and obtain such a hold as to reduce the velocity of the water. The flume, although also of gunite construction, was shot against forms, so that the surface exposed to the water is smooth, and comparatively little trouble with algæ has been experienced.

Water was first pumped into the canal early in April, 1918, and by the middle of May the growth had become so heavy that it began to fall off in large quantities.

Removable screens, having a ¼-in. mesh, were installed in the canal, and 0.8 lb. of copper sulphate per 1,000,000 gal. was introduced at the upper end of the canal. In spite of this, the growth so increased that by the end of May the length of time between cleaning of screens had decreased from 45 to 25 minutes. During June and up to July 20 there was less trouble, the screens requiring cleaning only once every hour. From



SCREEN WHEEL REMOVING ALGÆ FROM CANAL

this time on, however, the growth gave more trouble and up to Sept. 20 the screens were removed and replaced on an average every 15 minutes.

In August samples were taken for analysis and the results showed organisms as follows: Spirogyra, 4000

standard units per cubic centimeter; closterium, 20; penium, 40; raphidomanas, 100; amorphous matter, 1500. The predominating species was thus found to be the filamentous spirogyra, which could be killed in the continued presence of copper sulphate solution having a strength of 2.5 lb. per 1,000,000 gallons.

For the sake of convenience in operating, double this dose was introduced 12 hours of every day, commencing Sept. 15. Six days after this solution was applied, the rate of washing screens was reduced for two days to about once every hour. From Sept. 24 to 30 the rate was increased to about once every 20 minutes. Three days after the solution was introduced the algæ had commenced to die, turning brown in color, and in six days were practically all killed. The increase in cleaning screens during the latter part of the month was, of course, due to the dead algæ becoming loosened from the canal sides and falling off. From Oct. 1 to Dec. 18 little or no trouble resulted from this source, the screens requiring cleaning only once in 12 hours.

The copper-sulphate solution was introduced at a point about 20 ft. down from the beginning of the canal, and a striking indication is furnished here of the result of the treatment, for in this first 20 ft., which on account of the velocity of the water the solution does not touch, long "streamers" of the algæ are present, such as do not exist at any other point in the canal during treatment. A revolving ¼-in.-mesh screen driven by a water wheel placed in the canal was installed in an early attempt to do away with the expense of keeping a man continuously cleaning inclined stationary screens. The screen was revolved against the flow of the water in order to pick up the larger particles, which would otherwise have been rolled under it, and it was kept clean by jets of water flowing from the inside. The screen was partly successful. If made of steel with small clearances between the revolving and the stationary parts, thus preventing more of the algæ from going past the wheel it would be more satisfactory, but the principal difficulty experienced was the large quantity of water required to keep the screens clean, all of which had to be run to waste.

For dosing, a 9% solution of copper sulphate and water is mixed in a large wood tank and flows to a small orifice box alongside the canal, where the uniform head of solution is maintained over a ¼-in. orifice by means of a ball cock.

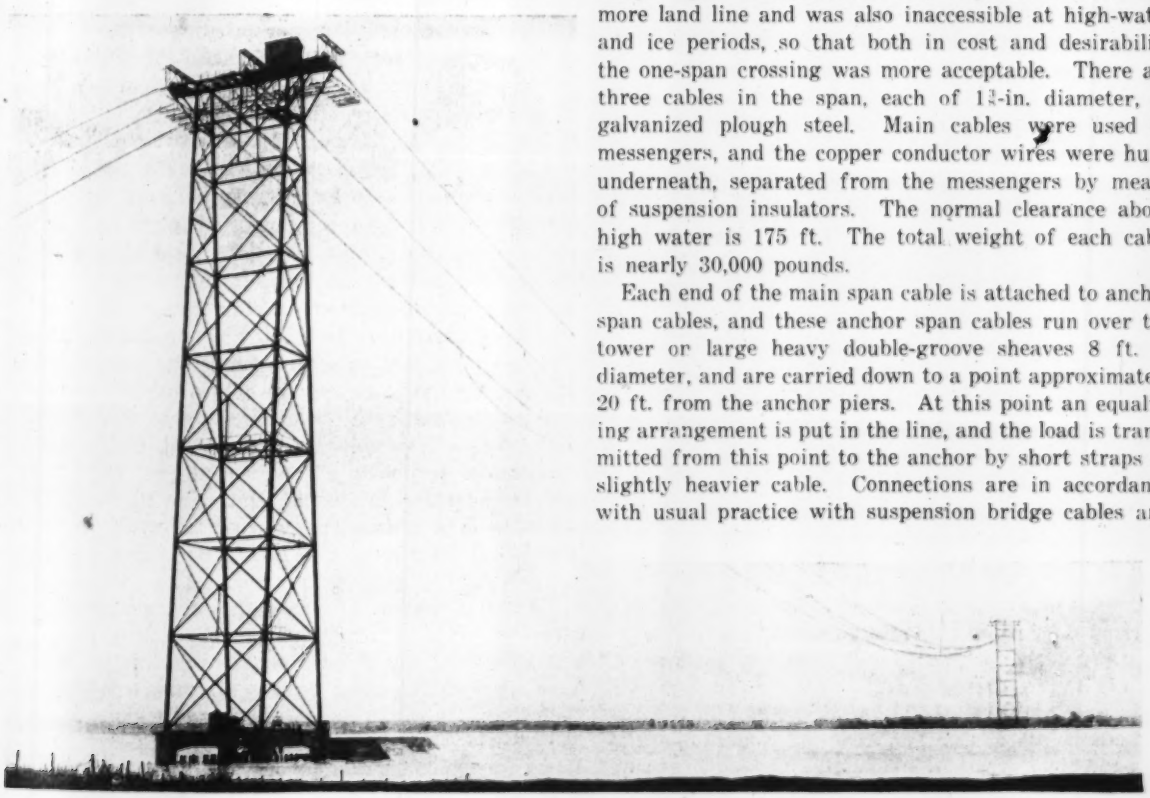
Transmission Line with 4801-Foot Span Over St. Lawrence

Longest Transmission Cable Span in World on Tower 350 Feet High Takes Place of Former Submarine Crossing

ACROSS the River St. Lawrence, about 20 miles from Three Rivers, the Shawinigan Water & Power Co. has just completed what is believed to be the longest transmission line span in the world. With a center span of 4801 ft. and anchor spans of 951 ft. and 571 ft., the total crossing is 6323 feet.

The line takes the place of an older submarine crossing, but has considerably greater capacity. It was adopted after an examination of several other competing locations, the first one of which was a three-span crossing with each span approximating 2200 ft. This simple span location, however, required considerably more land line and was also inaccessible at high-water and ice periods, so that both in cost and desirability the one-span crossing was more acceptable. There are three cables in the span, each of 1¾-in. diameter, of galvanized plough steel. Main cables were used as messengers, and the copper conductor wires were hung underneath, separated from the messengers by means of suspension insulators. The normal clearance above high water is 175 ft. The total weight of each cable is nearly 30,000 pounds.

Each end of the main span cable is attached to anchor span cables, and these anchor span cables run over the tower on large heavy double-groove sheaves 8 ft. in diameter, and are carried down to a point approximately 20 ft. from the anchor piers. At this point an equalizing arrangement is put in the line, and the load is transmitted from this point to the anchor by short straps of slightly heavier cable. Connections are in accordance with usual practice with suspension bridge cables and



TRANSMISSION LINE SPAN ACROSS ST. LAWRENCE IS NEARLY A MILE IN LENGTH

similar structures. Over the ends of the cables are placed massive steel bridge sockets having a tempered conical seat. The ends of the cables were broomed and carefully cleaned, and spelter was poured in between the wires and the sides of the seat.

The towers are of structural steel construction, and are 350 ft. high and 60 ft. square at the bases, the upstream and downstream faces tapering to a width of 14 ft. at the top. The tower foundation is made up of four circular reinforced-concrete piers 11 ft. in diameter placed on the corners of a 60-ft. square and connected by heavy reinforced-concrete beams 4 ft. wide by 8 ft. deep. These piers were sunk as hollow cylinders and afterward filled with concrete. The first 6-ft. lift of the cylinders was poured on a working platform and lowered in approximately 8 ft. of water down to the river bed, by means of 2-in. screws. The second lift, of approximately 6 ft., was then poured, and the cylinders were sunk by excavating inside with orange-peel buckets, but the lowering screws were left in place as a guide until the cylinders had reached a penetration of approximately 15 ft. From then on it was found unnecessary to use the screws. When a cylinder reached its full penetration of 40 ft. a plug of rich concrete was poured at the bottom and the inside was then filled with a leaner concrete.

The soil on which these cylinders rest on the north side is a very fine sand, on the south side a fine sand, clay and boulders. Test borings to a depth of more than 100 ft. did not show any rock. Probably rock would not be found until about 200-ft. depth was reached. In front of the foundations there are erected, as guard piers against ice, reinforced-concrete cribs filled with rock, carried up to an approximate level with the maximum recorded high water.

The erection of the cables was carried out under the direction of the engineering department by the construction forces of the company, under C. F. Saunders, general superintendent of construction. H. C. Huber was in direct charge of the job, with Thomas Burham as his assistant. The steel towers were erected by the Canadian Bridge Co. The design of the line was in charge of S. Svenningson, designing engineer of the company.

System Without Red Tape Makes Success of Day-Labor Road Maintenance

Ohio Highway Department Selects Superintendents for Ability to Accomplish Results—Employs Flexible Organization of Foremen and Patrolmen—Weekly Report Forms Show Exact Status of Each Job

FORCE-ACCOUNT maintenance and repair of Ohio roads have been used on account of the difficulty of obtaining reasonable contract prices under war conditions. System without red tape is the secret of the economic success of the plan. Reports and records are required as a certificate of results obtained, but are not permitted to pass in lieu of efficiency. "Horse sense" in the selection of superintendents has been another means of success. Technical knowledge of road-building is a requisite, but good judgment, experience, tact, and ability to get work accomplished, are equally fundamental requirements. Finally, success is clinched by a flexible organization of patrolmen, foremen and superintendents under the direction of resident and division engineers and subject to constant check and inspection by the officials of the State Highway Department. Output and quality of work are the only criteria which the department officials permit to count in passing on the performance of the repair and maintenance organization.

The procedure in organizing, directing and recording force-account operations is the conspicuous feature of the story of war-time maintenance of Ohio's state highways. Construction methods are not strikingly unusual and need no special consideration.

In every county in which the mileage of state roads warrants it, there is a definite organization for road maintenance and repair. Direct charge of field work is assigned to patrolmen, foremen and superintendents whose functions are as follows: Patrolmen are in charge of minor repairs on specified sections of road, and work alone or with one to six helpers; foremen are in charge of a gang of men, and work under the direction of a superintendent or a resident engineer; superintendents are in charge of large gangs such as would be required in resurfacing a road, or are in general supervision over several small gangs under foremen or patrolmen.

Superintendents are directly representative of the State Highway Department, but the resident engineer, who is the county representative, is their superior. Division or maintenance engineers, who work under the direction of the deputy commissioner and who have charge of many counties, direct the resident engineers.

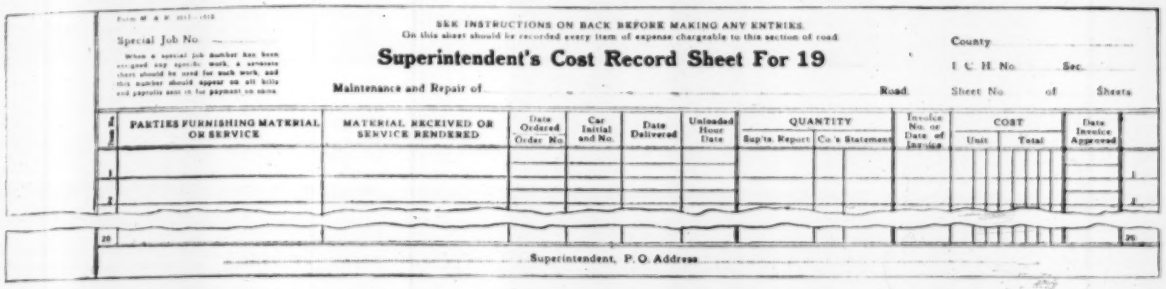
A map of all the state roads in the county is in the resident engineer's office. On this map, original construction contracts are designated by mnemonic symbols. A maintenance section may embrace one or more construction contracts, or may be only a part of one construction contract; whichever be the case, the contract section symbols, combined or subdivided, designate the maintenance section in all correspondence, construction reports and other documents relating to the work. If, for example, a maintenance section embraces contracts A and B, it is designated as Sec. A-B; if it is a part of contract A, it is designated as Sec. A-1 or Sec. A-2.

Allotted a section for repair, the superintendent goes over the ground, determines the availability of labor and materials, and decides on the construction procedure. His duties, then, besides directing construction operations, include keeping records and making periodical reports; obtaining direct shipment of, receiving and salvaging equipment and materials; approving payments for labor and materials, and distributing expenditures.

Three records, kept by the superintendent, furnish

all information required by the highway department regarding work on any maintenance section.

The labor and rental of equipment are recorded in a time book. Each double page of this book carries a name column, date columns for 31 days, and total time, rate, amount and "remarks" columns. In entering a labor or rental item, it is designated by a symbol to indicate one of the five kinds of maintenance and repair to which distribution of cost is made. These symbols are those used in making weekly reports, as described in a succeeding paragraph. Notice that in recording time, rental of equipment is carried in the time book and is included on the payroll with labor. The time book is the first record.



SEE INSTRUCTIONS ON BACK BEFORE MAKING ANY ENTRIES.

On this sheet should be recorded every item of expense chargeable to this section of road.

Superintendent's Cost Record Sheet For 19

Special Job No. ....

When a special job number has been assigned any specific work, a separate sheet should be used for such work, and this number should appear on all bills and payrolls sent in for payment on same.

Maintenance and Repair of ..... Road.

County .....

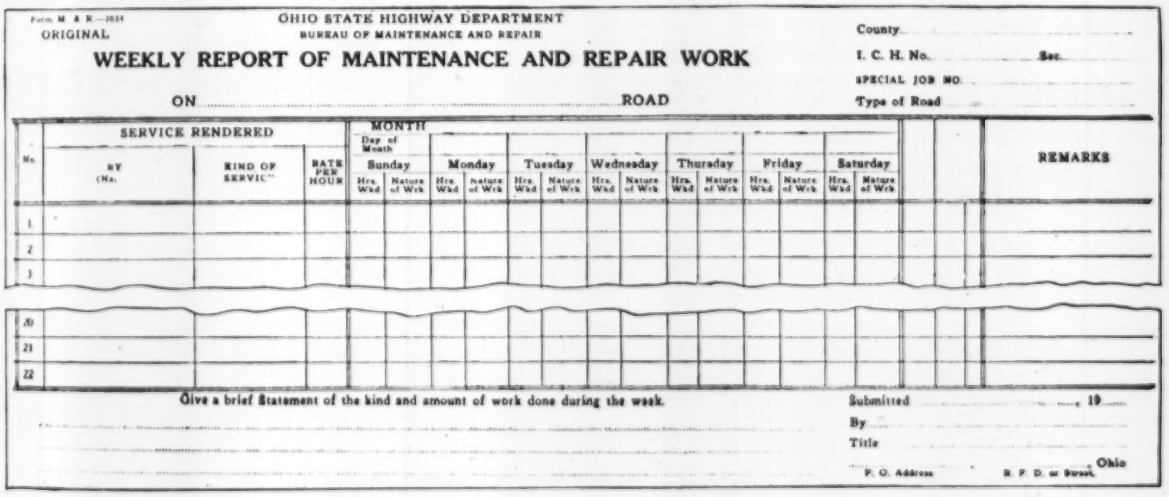
I. C. H. No. ..... Sec. .....

Sheet No. ..... of ..... Sheets

No.	PARTIES FURNISHING MATERIAL OR SERVICE	MATERIAL RECEIVED OR SERVICE RENDERED	Date Ordered Order No.	Car Initial and No.	Date Delivered	Unloaded Hour Date	QUANTITY Sup'ts. Report	QUANTITY Co.'s Statement	Invoice No. or Date of Invoice	COST Unit	COST Total	Date Invoice Approved	No.
1													1
2													2
20													20

Superintendent, P. O. Address .....

All expenses incurred on the work are kept on the superintendent's cost-record sheets—one set for each maintenance section. These sheets are the superintendent's record of work done and his certificate of expenditures. All entries are made closely to date, as the sheets are the running account of the work, and are subject to call and inspection at any moment by the State Highway Department. The heading of the face of one of these sheets is reproduced; on the back are four columns for



Form M. & R.—1914 ORIGINAL

OHIO STATE HIGHWAY DEPARTMENT
BUREAU OF MAINTENANCE AND REPAIR

WEEKLY REPORT OF MAINTENANCE AND REPAIR WORK

ON ..... ROAD

County .....

I. C. H. No. ..... Sec. .....

SPECIAL JOB NO. .....

Type of Road .....

No.	SERVICE RENDERED BY (No.)	SERVICE RENDERED KIND OF SERVICE	SERVICE RENDERED RATE PER HOUR	MONTH Day of Month Sunday Hrs. Wkd	Sunday Nature of Wk	Monday Hrs. Wkd	Monday Nature of Wk	Tuesday Hrs. Wkd	Tuesday Nature of Wk	Wednesday Hrs. Wkd	Wednesday Nature of Wk	Thursday Hrs. Wkd	Thursday Nature of Wk	Friday Hrs. Wkd	Friday Nature of Wk	Saturday Hrs. Wkd	Saturday Nature of Wk	REMARKS
1																		
2																		
3																		
20																		
21																		
22																		

Give a brief Statement of the kind and amount of work done during the week.

Submitted ..... 19....

By .....

Title .....

P. O. Address ..... R. F. D. or Street ..... Ohio

The cost-record sheets are the superintendent's field bookkeeping system. When every column has been filled, he possesses a verified record of every expenditure and one that is available for any kind of cost analysis which the department may wish to make.

Check of the progress on each maintenance section is maintained by the department through weekly reports from the superintendent. These weekly reports are intended to be a complete record of all operations performed and material received. They are made in duplicate and are numbered serially. By means of mnemonic symbols, a great volume of information is recorded on a sheet. The symbols show cost distribution according to features and work items. Thus, 5 in the "hours" column followed by B-50 in the "nature of work" column means that five hours' work in painting a bridge is to be charged to bridges and culverts. Numerals indicate work items; there are 42 regular work items and 13 extra numbers for special items for which some job may call. Reproduction of a portion of the face of a weekly report sheet shows the manner of reporting labor. On the back of the sheet are columns for reporting materials received and a schedule of symbols.

Cost distribution is divided into four classes: Road-bed, surface, bridges and culverts, and equipment and superintendence. Under "roadbed" are included all expenditures incurred by the grading of roadbed, repairing shoulders and ditches, cutting brush or weeds, repairing underground drains and guard rails, removing débris from culverts, etc. Surface expenditures are all those applied to the metalled portion of the road. Expenditures for bridges and culverts need no explanation. Under "equipment," only expenditures for new equipment and tools are included; "superintendence" includes

distribution of costs and a set of instructions for keeping the records. Note that both materials received and service rendered are entered, according to date. Thus, the amount of the biweekly payroll is entered on the date when the payroll is mailed to the office. So, also, entry is made of receipt of material and receipt of bill on the date received. If entries are made thus promptly and the sheets are periodically checked, any discrepancies, losses, injuries, etc., are caught and quickly rectified. Thus, the cost-record sheets are the superintend-

the money paid for supervision. For example, if a foreman does some manual labor, only that part of his time given to actual supervision is charged to superintendence.

Tools and equipment are regarded truly as investments to be kept in repair and properly housed to prevent deterioration and loss and, when no longer serviceable, to be salvaged. This maintenance is the responsibility of the superintendent.

Strict account is required of all tools and equipment. Every article is marked by die or stencil; where the number of tools warrants, tool boxes are provided and, in important instances, tool houses are built. Tools are checked daily, and search for missing tools is required to be prosecuted to the limit. Loss is reported immediately to the department with a full account of the circumstances. In brief, men in the field are made aware that no carelessness will be countenanced.

It is required that tools and equipment be kept in good condition by cleaning, oiling and painting, and proper preparation and housing for storage. When broken and worn tools have accumulated in sufficient quantity they are condemned and sold by a representative of the department. If tools or equipment are moved from one county to another the superintendent lists the items on an inventory sheet, and mails this sheet to the department. If the superintendent is transferred, he reports to the department the character, number and whereabouts of all tools and equipment left by him. Only by making such a list and obtaining a receipt from the new custodian is the superintendent relieved from responsibility.

Form G 4040

IMPORTANT—A full explanation must be given of any discrepancy existing between the number of tools listed in Column No. 1 and Column No. 4. When tools are reported as having been transferred to someone else, receipt from the party receiving same must be attached to this report.

PROPERTY OHIO STATE HIGHWAY DEPARTMENT

INVENTORY OF EQUIPMENT

In Possession of..... Address..... 19.....

Equipment is Located at.....

(If necessary give location in "Remarks" column)

	(1)	(2)	(3)	(4)	(5)	(6)	
ITEMS	On Hand ..... 19... Time of Last Report	Received or Purchased Since Last Report	Transferred to (Attach Receipt to This Report)	Now on Hand ..... 19...	Held for Disposal Account Broken or Worn	Condemned by	REMARKS
Adze—R. R. No. of							
Axes—Hand, No. of							
Axes—Stone, No. of							
Axes—Wood, No. of							

At regular intervals, on demand by the department, inventories are made of all tools and equipment. The department furnishes a special folder sheet of five foolscap pages, on the sides of which the equipment items are printed, as indicated by the form reproduced in part.

Except in cases of emergency, no materials or tools are purchased otherwise than through requisition by the superintendent approved by the resident engineer. Requisitions are not merely perfunctory statements of articles required. Besides exact statements of the items, a statement is required of the purpose for which they are wanted. Route and destination and rate of shipment have to be stated. Finally, a list is required of firms, particularly local firms, interested in furnishing the articles. The department does the purchasing after competitive bids are received.

Emergency purchases are of two kinds, purchases of considerable quantities and purchases of small articles and supplies. In making larger purchases, the superintendent, after he has bought, makes out a requisition specifying the goods and explaining the reason for the emergency action, and sends this requisition to the department, which issues a confirming order to the concern from which the purchase was made. To purchase small articles, the superintendent makes out a field order in triplicate, one copy for the dealer, one for the department and one for his own records.

When material has been ordered by the department, a copy of the order is sent to the superintendent, and thereafter it is his duty to see that shipments come as ordered and are cared for promptly when received. Prompt unloading is demanded to reduce demurrage, and the occasion for every bill for demurrage has to be explained. The department is kept informed concerning materials received through the weekly reports previously described.

Salvage is insisted upon. Not alone surplus materials, but containers and scrapped tools and equipment are salvaged. It is required that barrels containing road oils be tapped, and the contents so drawn off as to leave the container intact. The salvage and return of cement sacks are watched carefully. In the same way, surplus material is assembled and stored for future use. All payrolls and bills for materials, equipment and supplies are paid directly by the state. The only exception is an occasional small purchase by the superintendent, for which he pays cash and is reimbursed by the state. Payrolls are made up and mailed on the 15th and last days of the month. They are duplicates of the time book, with columns for signatures of the men and for the officials vouching for and approving the figures. Individual warrants issued by the state for the men are sent to the superintendent for distribution. Bills for materials and supplies go to the superintendent, and are checked up against his cost record-sheets, stamped "approved" and returned to the department for direct payment. Heading the department operations is Clinton Cowen, state highway commissioner. A. H. Hinkle is deputy state highway commissioner, in charge of maintenance and repair.

Telephoned from Regular Desk Phone to Airplane

Communication between an airplane in the air and a regular telephone on the Washington city line was established for the first time Jan. 16 by the Army aëronautic corps. The two links of the line were the radiotelephone from the plane, which was flying over Bolling Field, outside of the City of Washington, to a small station on the field, and the city telephone system from Bolling Field to the the office of Major General Kenly, director of military aëronautics. Conversion of radio to direct wire communication was made automatically by an apparatus devised by Army officers.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Road and Street Engineers' Vade Mecum

AMERICAN HIGHWAY ENGINEERS' HANDBOOK—Editor-in-Chief, Arthur H. Blanchard; Associate Editors, Charles J. Bennett, Harold S. Boardman, Mark Brooke, William H. Connell, Walter Wilson Crosby, Arthur W. Dean, Henry B. Drowne, Austin B. Fletcher, Henry A. Gardner, Prévost Hubbard, James F. Kemp, Nelson P. Lewis, Frederick K. Morris, Joseph Hyde Pratt, John R. Rablin, Francis P. Smith, George W. Tillson. New York: John Wiley & Sons, Inc. Leather; 4 x 7 in.; pp. 1658; illustrated. $5.

Professor Blanchard and his 17 associate editors, with their unnamed "collaborators," have produced a handbook which for scope and detail of treatment within one single specialized field of engineering will probably remain unexcelled for some time. The editor-in-chief says in his preface that the volume was designed as "a reference book which would include reliable and comprehensive information on all branches of highway engineering and related subjects which would prove useful to highway officials, engineers, chemists, contractors, and engineer-salesmen of highway materials and machinery." This aim seems to have been amply fulfilled. If there be anything lacking, the reference lists of books and periodicals at the end of each of the 29 sections point the way to finding it, while for the material given in the handbook itself the General Contents, the Contents at the head of each chapter, and the 78-p. index of some 8000 entries, serve as ready guides. Another noteworthy feature of the volume is its reprinting in full of a large number of standard tests and specifications.

A detailed analysis of the volume would fill columns. A general idea of its contents is afforded by the following regrouping of sections so as to bring together the work of each editor: First, the editor-in-chief, Arthur H. Blanchard, consulting engineer, New York City, is responsible for the useful terminology, both American and British, with which the volume opens, as also for the treatment of bituminous (1) surfaces; (2) macadam, and (3) concrete. To Harold S. Boardman, dean of the College of Technology, University of Maine, fell (1) mathematics, mechanics and structural materials and (2) highway bridges, culverts, retaining walls, foundations and guard rails. James F. Kemp, professor, and Frederick K. Morris, instructor, in geology in Columbia University, dealt with engineering geology. W. W. Crosby, consulting engineer, Baltimore, treated (1) preliminary investigations, (2) brick and (3) cement-concrete pavements. Henry R. Drowne, engineer Lane Construction Co., Baltimore, handled (1) surveys and office practice, and (2) planning roads and road systems. N. P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City, contributed (1) planning streets and street systems, and (2) financing highway improvements. Austin B. Fletcher, engineer, California Highway Commission, stands for grading, drainage and foundations. To Joseph H. Pratt, consulting engineer and secretary of the North Carolina State Highway Commission, was assigned earth and sand-clay roads; to Charles J. Bennett, state highway commissioner of Connecticut, gravel roads; to Arthur W. Dean, chief engineer, Massachusetts Highway Commission, broken-stone roads, and to Prévost Hubbard, chemical engineer, United States Office of Public Roads, bituminous materials. John R. Rablin, engineer, Metropolitan Park Commission of Massachusetts, covered dust palliatives, and Francis P. Smith, consulting chemical and paving engineer, New York City, sheet and rock asphalt pavements. George W. Tillson, [lately] consulting engineer to the borough president of Brooklyn, New York City, contributed (1) wood, and (2) stone-block pavements; (3) car tracks and pipe systems, and (4) comparison of types of roads and pavements. William H. Connell, engineering executive, Day & Zimmerman, Philadelphia, wrote (1) street cleaning, collection and disposal of city wastes and snow removal, and (2) organization and administration of highway departments. Mark Brooke, colonel of engineers, U. S. A., had charge of sidewalks, curbs, gutters and highway signs. Finally, the section on the preservation of materials used in highway structures was proposed by Henry A. Gardner, assistant director of the Institute of Industrial Research, Washington.

The volume contains many convenient tables and diagrams. Particular mention may be made of those giving external and skew distances for 25-ft. radii, arcs for 100-ft. tangents, and deflections for 100-ft. arcs. These should be very useful in compiling final staking-out notes, and also for preliminary locations, except that as for the latter the volume is too large and unwieldy for field work.

The bulkiness of the volume is in part due to an attempt to pack into a single volume as much as possible of every subject the highway engineer would ever wish to know about. The sections on mathematics, engineering geology, planning streets and street systems, and street cleaning and waste disposal, to name only four, contain material which but few highway engineers will ever have occasion to use. The paragraph describing an incinerator for mixed refuse sounds like the unrealized dream of an inventor. It certainly fails to give an idea of any incinerator ever put into common use.

The wonder grows how publishers of engineers' handbooks can continue to give increasing amounts of information prepared by specialists—in fact, nothing short of a whole series of monographs between one pair of covers—without doubling or trebling the price charged for the earlier reference works. May the time not yet come when the practice, like the street-car ride of almost unlimited length for a nickel, will break down of its own weight? Meanwhile, purchasers of handbooks need not complain, unless they would prefer less bulk at a lower price.

Formula Charting

Reviewed by ROBERT C. STRACHAN
Civil Engineer, New York

GRAPHICAL AND MECHANICAL COMPUTATION—By Joseph Lipka, Ph.D., Assistant Professor of Mathematics in the Massachusetts Institute of Technology. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 264; illustrated. $4.

The author of this volume has produced a treatise that is admirable not only for its clarity of diction and logical sequence of ideas, but also because it sets before the general scientist and the engineer principles and processes of the greatest practical utility, which heretofore have not been easily accessible in their entirety. Those who were interested have found it necessary to gather from scattered sources the matter here brought together in a form adapted to the use of practitioners as well as students.

The English bibliography of formula charting is decidedly limited; much of the discussion on methods of forming empirical curves to fit experimental data must be searched out in the proceedings of scientific societies and the contents of scientific periodicals here and abroad; and of the many explanations of the well known slide-rule principle but few contain any attempt to link up that principle with more general conceptions.

Professor Lipka has brought between two covers a well executed presentation of all these related subjects. It should not be understood from this statement that the book is merely a compilation, for it is decidedly not, in the usual sense. The author has summarized and correlated the work of many others, intermingling an amount of his own that is by no means negligible.

In the opening chapter are set forth the elementary principles of the representation of functions by scales, followed by the extension of these principles to include the so-called Mannheim slide rule, the log-log slide rule and others; after which the author proceeds to the graphical solution of equations containing two or more variables, and thence to the subject of nomographic or alignment charts. Probably there is at present no other work in English in which this subject is treated with equal comprehensiveness. Runge, it is true, has devoted some attention to it in his "Graphical Methods," but in so perfectly generalized a fashion that his reader may easily fail to see its true bearing; while the excellent work of Professor Peddle is more restricted in scope.

Professor Lipka's method resembles quite closely that of Maurice d'Ocagne. His underlying theorems are demonstrated in full, and his charts worked out to completion. To many they will be a surprising revelation of the possibilities of graphical methods in enabling one to avoid the drudgery of numerical computation.

The formulas selected for manipulation are typical ones, and similar methods may be applied readily to many others which will suggest themselves to the reader, as bearing on his particular kind of work.

In the highly enlightening chapters on the building of empirical formulas, the interpreting of experimental data and graphical interpolation, the author enunciates the criteria by which to determine the species of curve giving the best representation of a given set of data, and shows in detail, for a large number of actual experimentation reports, the practical processes of deriving such curves and evaluating their constants. The author's well considered order of presentation now becomes apparent, for the reader will at this point realize that, however complicated may be the representative curve with which he has to deal, he is prepared to devise some form of chart by which its equation may be rapidly solved.

The final chapter contains a very lucid exposition of the principles of graphical and mechanical differentiation and integration, leading naturally to the description and analysis of the planimeter, the integraph and the differentiator with which the book closes.

At the end of each chapter are given problems, the solution of which will be of great benefit to students. The illustrations are numerous and well rendered, the typography is of a pleasing clearness. The index is proof that the author has not lost sight of the practical needs of the reader. The book deserves the highest success.

Bettering Municipal Government

OUR CITIES AWAKE: Notes on Municipal Activities and Administration—By Morris Llewellyn Cooke, M. E., Consulting Engineer, Formerly Director of Public Works, City of Philadelphia; With a Foreword By Newton D. Baker, Secretary of War, Formerly Mayor of Cleveland. New York: Doubleday, Page & Co. Cloth; 6 x9 in.; pp. 347; illustrated. $2.50

Concerned largely with experiences in Philadelphia while the author was Director of Public Works in the reform Administration of Mayor Blankenburg, and drawing also upon the author's observations on business efficiency and municipal government before and since then, this volume contains much which should be a help and inspiration to those who wish to improve the municipal government of any city, large or small.

Owing to an apparently haphazard presentation of the many topics discussed, it is difficult to give, without undue detail, a clear idea of the contents of the volume. After a few pages about service to citizens and some observations on encouraging the people to make complaints, the book plunges into budgets and appropriations, then as suddenly takes up "contract jockeying" and "political assessments." Next came chapters on some phases of the framework of government, the science of management, and "The One Best Way." The chapter last named opens with remarks on "coöperation with the people," but deals mostly with standardization. Succeeding chapters take up public servants in general, the civil service, publicity and utilities. Then comes a chapter, entitled "The City as an Ally of Industrial Progress," which has to do with markets, civic centers, public parks and baths, business men's associations, commercial and vocational guidance, and other subjects. The two final chapters consider similar topics, and touch again upon some of the earlier ones.

The value of the book lies chiefly in its accounts and interpretations of the author's personal experiences as Director of Public Works and the knowledge thus gained of Philadelphia misgovernment under earlier administrations. Useful also are comments on some phases of scientific management and on the newer experiments in municipal government, such as the commission and manager plans. The discussion of civil service, under the heading "Finding the Man in Ten Thousand," is perhaps the most valuable part of the book—at least for the readers of this journal. The part of this chapter which considers the selection of

men for "$3000 plus" positions deserves wide attention. The most pungent chapter is "Our Utilities and Their Owners." Here the author says many sharp and some harsh things, most of which have at least some warrant in view of the extent to which utility exploitation has been carried in this country. Strong expressions and even some bias may be expected from any writer discussing utilities from the public viewpoint, but Mr. Cooke seems to show an unwarranted excess of bias, particularly toward engineers in general who have served on the side of the utility companies in valuation and rate cases. True, he points out that our whole system of expert testimony in court practice begets partisanship instead of a devotion to truth, but that does not warrant classing all who testify for utility companies as, by that fact, venial, any more than it warrants sweeping condemnation by the private interests of those who testify on the city's side, as has been done more than once by men who ought to be above such extreme partisanship.

The book has no index. This, and the fact that some of the chapters and the book as a whole are literary medleys, may seem surprising in a volume written by an exponent of scientific management, but the book does not pretend to be a scientific treatise, and despite its scrap-book tendency it is bound to have a salutary effect as a source of inspiration for better municipal government.

Utility Rates

REVIEWED BY FREDERIC P. STEARNS

Consulting Engineer, 1 Ashburton Place, Boston, Mass.

PUBLIC UTILITY RATE FIXING—By C. E. Grunsky, Eng. D., Consulting Civil Engineer, M. Am. Soc. C. E., President, American Engineering Corporation, President, California Academy of Sciences, Etc. San Francisco: Technical Publishing Co. Cloth; 6 x 9 in.; pp. 169; illustrated. $2.50.

A number of articles dealing with the problem of fixing public utility rates and with related matters, originally contributed to the *Journal of Electricity*, have been assembled in this volume. One of the articles, entitled "Fair Value and the Rate Base," was written by Capt. C. E. Grunsky, Jr.

To a large extent the book reiterates the views expressed by the author in his book entitled "Valuation, Depreciation and the Rate Base" (reviewed in *Engineering News*, March 15, 1917) and in other previous writings. As a rule, the changes made are not along the lines indicated by the most important court decisions and by the present practice of valuation engineers, public service commissions and progressive corporations.

The author makes frequent reference to his view that it is illogical to make value which results from earnings the basis of rates, and objects to the use by valuation engineers and public service commissions of "value" as a rate base, not noting that the so-called "value" used by them is not deduced from earnings but is obtained in nearly the same way as the author's rate base, the important difference being that the author would not deduct accrued depreciation.

He also gives prominence to the view "that accrued depreciation is not an element for consideration when rates are to be fixed," and that annual or accrued depreciation need not be determined. Instead of the latter, he would substitute in fixing rates an indefinite "replacement requirement," which is apparently a yearly sum for each plant unit that with interest would be sufficient to replace the unit at the end of its probable life, or, as an alternative, the amount actually required for replacement in a given year. To use his own words (p. 152), the replacement requirement "would have to be approximated on the basis of past experience, and would naturally be so distributed over a series of years, preferably in anticipation of the requirement, that rates once established would not have to be modified too frequently. It will be immaterial how the requirement is ascertained. Any method of procedure which will fairly approximate the desired result will suffice."

The importance of annual depreciation in determining rates is best indicated by an actual example. The Bell telephone system of the United States in 1917 earned, in round numbers, for depreciation $53,000,000, and for current maintenance $41,000,000. The depreciation item is larger than that for dividends. Were the telephone companies to accept the author's views in regard to replacement requirements as a substitute for depreciation, the amount to be earned for this item at the higher rate which the author has suggested would be many millions less than the present sum for depreciation, and at the lower rate by far the larger part of the item would be eliminated. In the latter case, it is sometimes asserted that as the depreciation is not collected as it accrues the future ratepayers are under obligation to pay it at a later date, but as the Supreme Court in the Knoxville case has ruled that "it is the duty of corporations to exact sufficient returns to keep the investment unimpaired," it is not likely that any such obligation would be recognized.

In regard to determining the annual return after having determined the rate base, the author deals at considerable length with the legitimate earnings on invested capital, holding that there should be a proper interest return and a profit, this profit to be made up of compensation to the owner of the property for hazard, for management, and as his share in the general prosperity of the community. He introduces the view that this profit should be a percentage upon the gross earnings and not upon capital.

There are chapters relating to the appraisal of real estate adapted for special use, to the determination of the value of real estate in eminent-domain proceedings, to the value of water rights, and to the rate of return, which contain decisions on some of these matters as given in San Francisco water-rate cases recently decided; also a chapter relating to the rate schedule.

Methods and Economics of Storing

STORING: Its Economic Aspects and Proper Methods—H. B. Twyford, Otis Elevator Co., Author of "Purchasing: Its Economic Aspects and Proper Methods." New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 196; illustrated. $3.50.

Intelligent storing bulks large in the success of manufacturing and mercantile operations. Numerous factors such as fluctuation in prices, rise and fall in demand and continuity of production, must be carefully integrated by the successful storekeeper. Besides these, the technique of storekeeping, such as storeroom location and equipment, storeroom appliances and accounting methods, must be known. Finally, the storekeeper must have a keen perception of the fact that storing is a

definite and important expense in the conduct of a business. Both the economics and the technique of storing are well presented in Mr. Twyford's new book.

Of the 12 chapters, three discuss the economics and outline the principles of storing. The fourth chapter presents the exceedingly important question of precise designation of stored articles by standard definitions and specifications. Five subsequent chapters discuss the location and arrangement of storerooms, storeroom equipment and appliances, and storeroom accounting and record-keeping methods. Organization of the stores department and the functions of the various employees are outlined in Chapter IX. The processes of receiving into and delivering from stores are described in the final two chapters. Nearly a hundred illustrations of equipment, appliances and bookkeeping and inventory forms add materially to the value of the volume.

A Great American Engineer

GEORGE WESTINGHOUSE: His Life and Achievements—By Francis E. Leupp. Boston, Mass.: Little, Brown & Co. Cloth; 6 x 9 in. pp. 300; illustrated. $3.

Since Smiles wrote his famous "Lives" sixty years ago, biographies of engineers have been few. Smiles wrote of British engineers. Except for sketches and two or three more ambitious attempts, the lives of American engineers have heretofore gone unrecorded. Hearty welcome, therefore, to Mr. Leupp's well-rounded and readable story of one of America's great inventors, engineers and captains of industry.

After touching on Westinghouse's boyhood, Army and Navy experience in the Civil War, and three months' uninterested trial of "the French and German languages, solid geometry, and English rhetoric, essays, and vocal training" at Union College, the author starts with Westinghouse's career as inventor and manufacturer—already foreshadowed by a rotary engine which he built before going to war. A car replacer, suggested by a tedious wait due to a train wreck, was his first commercial venture. With this he made and marketed cast-steel reversible railway frogs. Marvelous successes with the railway air brake, alternating current and other electric developments—lighting the Columbian Exposition, elevated-railway electrification, Niagara power—the introduction of natural gas, the gas engine and the steam turbine, are all told. A good idea is given of the variety and magnitude of Westinghouse's manufacturing operations and his masterful control of their organization and financing up to the receivership of the Westinghouse Electric & Manufacturing Co. in 1907. The home, social and other personal relationships of Westinghouse are briefly presented.

The book is addressed to the nontechnical reader, but its engineering detail is sufficient for most engineers who are not specialists. In his preface the author says:

> One day, let us hope, we may have from the pen of some well known expert in technology an adequate summary of what the whole world's industrial advancement owes to the work of the eminent inventor. The mission of the present volume is simply human. It will have been accomplished if it conveys to the young man of today a sense that his career will depend for success less on the splendor of its start than on the spirit in which he pursues it; far less on capital than on courage, on worry than on watchfulness, on "pull" than on perseverence.

Until the experts in technology, as Mr. Leupp calls them, find time and courage—and perhaps we should say gain skill—to write biographies, we shall have continued reason to be grateful to the Smiles and Leupps who portray the "human" side of engineers. May their tribe increase!

A South American On Retaining Walls

RETAINING WALLS: Based Entirely on the Theory of Friction—By Pedro J. Dozal, C. E., Escuela Nacional de Ingenieros de Mexico. Done into English by R. T. Mulleady, B. Sc. Eng. (Birmingham). The Author, Buenos Aires. Cloth; 7 x 10 in.; pp. 155; illustrated.

On the whole, this book is an earnest and sincere, though labored, attempt to analyze earth pressure. The author's basic method of attack is to determine, from some sliding wedge, the force component parallel to the plane of slip, or, in the author's terminology, the plane of condition. This component is in part neutralized by the frictional resistance along this plane of condition. The remaining part of the component is termed the "unbalanced force." The maximum value of this unbalanced force, and also the maximum value of its horizontal and vertical components, are determined by the ordinary processes of the differential calculus. In a "coherent" mass it is assumed that in addition to the frictional resistance there is also a shearing resistance along the plane of slip, and it is the aim of the analysis to find the plane of minimum resistance. The thrusts found are considerably less than those given by Rankine's and Coulomb's methods. The author ignores any frictional resistance between the wall and the earth.

Fundamentally, the author has failed to notice that the maximum wedge of displacement does not always produce the maximum thrust upon the wall. It is essential to find what impending wedge of displacement produces the maximum thrust upon the wall. This is done by the method given by Coulomb, with the elegant graphical scheme of Poncelet.

From the matter contained in the book, it appears that the author is unfamiliar with the large mass of modern literature on the subject. Levy, Boussinesq and Resal of France and Cain of America have compiled a vast amount of information on earth pressures covering every possible condition and making parallel comparisons with experimental data.

In his preface the author says that "no writer has investigated as to whether a plane cutting an homogeneous and strongly coherent solid receives any pressure from that solid." The facts are quite the reverse. The lateral displacement of solids due to vertical loading forms an important basis of the theory of elasticity and is given by the classic "Poisson's Ratio." Again, on p. 25, after an intricate explanation quite lacking in rigor, it is stated as proved that the surface of rupture for a coherent mass is a plane. Experiment easily demonstrates that such a surface is not a plane, and careful mathematical analysis has shown the same—see, for example, Resal, "Poussée des Terres," Part II, and Cain, "Earth Pressure."

Although the book is entitled "Retaining Walls," it is, like a number of other books unhappily so named, a dissertation on earth pressure, with a minute appendage on gravity masonry walls containing nothing

of novelty. The book in itself is interesting in its carefully developed algebraic analysis; however, it is universally conceded that the action of earth masses has exhausted the efforts of mathematical and engineering science, and it has been shown that when retaining walls fail they rarely do so because of faulty earth pressure theory but generally because of faulty wall or foundation details.

Municipal Ownership Under the Microscope

THE RESULTS OF MUNICIPAL ELECTRIC LIGHTING IN MASSACHUSETTS — By Edmond Earle Lincoln, M.A. (Oxon.), Ph. D., Instructor in Economics, and Tutor in the Division of History, Government and Economics, Harvard University. Boston and New York: Houghton, Mifflin Co. Cloth; 5 x 8 in.; pp. 478; illustrated. $3.

In his painfully laborious study, which appears to be almost as painfully conscientious in its attempt at impartiality, Mr. Lincoln may be said to have put municipal ownership of electric-light plants in Massachusetts under the microscope. So minutely detailed are the facts and figures, and so many are the qualifications after a general conclusion has been drawn, that nearly 500 closely printed though typographically clear pages are filled.

There is no denying that the study is a valuable one, for besides the internal evidence there is the testimony that it won a $1000 prize which is not lightly awarded. Whether the same amount of effort, directed in some other of many possible channels of investigation, would not have proved more beneficial to humanity in general and to the author in particular—barring possibly the $1000 price—we shall leave to the judgment of the author—say a quarter century hence—with little doubt in our minds what his conclusion will be.

Not for the sake of contrast, but to throw light upon municipal ownership results, the author selected for comparative study privately owned plants of as nearly like character as feasible. This, he thinks, put private ownership to a disadvantage, because the smaller private plants are under a handicap as compared with the larger private plants. But if one looks beyond Massachusetts does not this argument work both ways? However, the study was—and that, too, for good and sufficient reasons—confined to Massachusetts, which enjoys the distinction of having begun state regulation of gas and electric lighting long before any other American commonwealth did, and which put the municipally as well as the privately owned plants under the control of the commission.

After a short introduction, the author presents a sharply critical survey of the literature on municipal electric lighting in the United States. We leave those castigated to defend themselves as best they can. Then comes an illuminating review of the work of the Massachusetts Gas and Electric Light Commission, and then an outline of the author's plan for his main task. The body of the book is devoted to minute analyses and comparisons of the recent physical and financial statistics of the 39 municipal and the 33 selected private plants, and to observations based on local personal surveys or examinations of some of the plants. The plants studied were divided, under each class of ownership, into those generating and those buying their current—the plants serving as mere distributors of current being a large percentage under each class of ownership. Each chapter has a series of numbered conclusions—a welcome and almost necessary feature in so detailed a volume, with its running conclusions and their qualifications. A chapter of general conclusions, 10 pages long, sums up the whole investigation. There are 18 pages of references and a statistical appendix of 44 pages.

The main conclusions of the author, while in many respects favorable to the municipal electric light plants studied, are adverse to municipal ownership. Whatever advantages the plan may seem to have produced in Massachusetts the author thinks are offset or nearly offset by disadvantages, and the consumers under private ownership have been so well protected by the Gas and Electric Light Commission that the risks of municipal ownership seem to the author to be quite unwarranted. These risks, he thinks, are looming up in the future, as the plants become older, and in view of the growing tendency for small plants to buy instead of generate their current.

The book would have been clearer and stronger had the author set up a few main standards before starting his general discussion, and consolidated and measured his multitudinous conclusions against them. Moreover, with all his infinite labor and pains, he has done little to show how the consumers and taxpayers directly concerned feel towards municipal ownership. Instead, he sets up his own dicta as to how they should or at least might feel. The balance against municipal ownership—if such it can be called—found by the author does not seem to be so large that the people of the 39 Massachusetts communities concerned might not gladly shoulder it for the sake of whatever satisfaction they may take in owning and managing their electric lights.

The officials and citizens of any community which is considering municipal ownership, whether of electric light or other utilities, or which is in doubt as to the wisdom of continuing to operate a given utility, might well read this book—following in most cases the author's suggestions for judicious skipping of much of the detailed discussion.

Finding and Recording Costs

COST ACCOUNTING—By J. Lee Nicholson, C. P. A., Instructor Cost Accounting, Columbia University, 1912-16; and John F. D. Rohrbach, C. P. A., Instructor Cost Accounting, Columbia University. New York: The Roland Press Co. Leather; 6 x 9 in.; pp. 576; illustrated. $6.

The demand for production cost figures and the improvements in accounting procedures have grown to such an extent in the past few years as to lead to the expansion of the senior author's "Cost Accounting, Theory and Practice," published in 1913. Besides describing the general methods of cost finding, factory routine, the summarization and control of cost records and the installation of a cost system, the author deals at some length with cost-plus contracts. He makes especial reference to the problems and difficulties that have arisen in interpreting the terms of the numerous Government contracts made during the war period, and their cancellation. He also includes a detailed discussion as to what may be chargeable to such contract work. There are separate chapters on materials, wage systems, labor reports and depreciation.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN PROBLEMS OF RECONSTRUCTION: A National Symposium on the Economic and Financial Aspects—Edited by Elisha M. Friedman, with a Foreword by Franklin K. Lane, Secretary of the Interior. New York: E. P. Dutton & Co. Cloth; 5 x 8 in.; pp. 464; illustrated. $4.

APPLIED MECHANICS—By Charles E. Fuller, S. B., and William A. Johnston, S.B., Professors of Theoretical and Applied Mechanics, Massachusetts Institute of Technology. Vol. II. Strength of Materials. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 556; illustrated. $3.75 net, postpaid.

ATLANTIC INTRACOASTAL CANALS: Report of the Bureau of Foreign and Domestic Commerce on Deep Sea-Level Canals Connecting Massachusetts Bay and Buzzards Bay, New York Bay and Delaware River, and Delaware River and Chesapeake Bay. Washington, D. C.: Department of Commerce. Paper; 6 x 9 in.; pp. 139; illustrated.

BOARD OF PUBLIC UTILITY COMMISSIONERS: Statistics for 1917—Trenton, N. J.: The Commission. Paper; 6 x 9 in.; pp. 48.

Shows assets, liabilities and income accounts for privately owned steam and electric railways, and gas, electric, water and sewer companies, having revenues of more than $10,000 in 1917.

BUILDING CODE, STATE OF WISCONSIN, REVISED 1918—Madison Wis.: Industrial Commission of Wisconsin. Paper; 6 x 9 in.; pp. 120; illustrated.

This code was originally issued in 1914 and revised in 1915. The present edition contains "a few necessary changes," based on experiences of the past three years "in the requirements for fire protection, sanitation and structural safety in the construction of buildings in this state.

CENTRAL STATION HEATING: Its Economic Features with Reference To Community Service—By John C. White. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 23; illustrated. 5c. from Superintendent of Documents.

CONVEYANCE AND DISTRIBUTION OF WATER FOR WATER SUPPLY: Aqueducts, Pipe-Lines and Distributing Systems—A Practical Treatise for Water-Works Engineers and Superintendents—By Edward Wegmann, C. E., M. Am. Soc. C. E., American Water-Works Association, New England Water-Works Association. New York: D. Van Nostrand Co. Cloth; 6 x 9 in., pp. 663; illustrated. $5.

DRAFTING-ROOM METHODS—STANDARDS AND FORMS: A Reference Book for Engineering Offices and Draftsmen—By Charles D. Collins, M. Am. Soc. C. E. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 149; illustrated. $2.

EXTINGUISHING AND PREVENTING OIL AND GAS FIRES—By C. P. Bowie. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 50; illustrated. 20c. from Superintendent of Documents.

THE FOUNDATIONS OF NATIONAL PROSPERITY: Studies in the Conservation of Permanent National Resources—By Richard T. Ely, Professor of Political Economy in the University of Wisconsin; Ralph H. Hess, Associate Professor of Political Economy in the University of Wisconsin; Charles K. Leith, Professor of Geology in the University of Wisconsin, and Thomas Nixon Carver, David A. Wells Professor of Political Economy in Harvard University. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 378; illustrated. $2.

GASOLINE AND KEROSENE CARBURETORS: Construction—Installation—Adjustment—By Victor W. Pagé, M. S. A. E., Author of "The Modern Gasoline Automobile," "Automobile Repairing Made Easy," "Aviation Engines," etc. New York: The Norman W. Henley Publishing Co. Cloth; 5 x 8 in.; pp. 206; illustrated. $1.50.

This book will interest owners and drivers of automobiles and auto trucks because it is a practical treatise on fuel economy and deals comprehensively with the subject of kerosene for fuel.

HANDBOOK ON EMPLOYMENT MANAGEMENT IN THE SHIPYARD. Dealing with Modern Methods and Practices of Employment Management. Bulletin II. The Employment Building. Philadelphia, Pa.: U. S. Shipping Board Emergency Fleet Corporation. Paper; 8 x 10 in.; pp. 29; illustrated.

HEALTH ALMANAC FOR 1919—Compiled by R. C. Williams, Assistant Surgeon, U. S. Public Health Service. Prepared by Direction of the Surgeon General. Washington, D. C.: U. S. Public Health Service. Paper; 6 x 9 in.; pp. 43; illustrated.

IOWA ENGINEERING SOCIETY: Proceedings of Annual Meeting held at Waterloo, Feb. 20-21, 1918. Iowa City, Iowa: The Society. Paper; 6 x 9 in.; pp. 169; illustrated. 50c.

JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS: Proceedings, Nov., 1918—Boston, Mass.: S. Everett Tinkham, Secretary and Librarian. Paper; 6 x 9 in.; pp. 35; illustrated. 50c.

LOGARITHMS OF HYPERBOLIC FUNCTIONS TO TWELVE SIGNIFICANT FIGURES—By Frederick E. Pernot and Baldwin M. Woods. Berkeley, Cal.: University of California. Paper; 7 x 10 in.; pp. 170.

The range covered by these tables is from 0.000 to 2.000, with a tabular interval of 0.001. For the entire range the sinh, cosh, and tanh are given. For the first quarter of this range—namely, up to 0.500—values of log sinh x/x and log $x/\tanh x$ are given, also to the interval of 0.001. Other high-precision tables of hyperbolic functions do not give figures below 0.500, and thus an essential need is provided for by the present work. An introductory text explains the method of calculating the tabular values.

METHOD OF LEAST SQUARES APPLIED TO ESTIMATING ERRORS IN COAL ANALYSIS—By J. D. Davis and J. G. Fairchild. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 36; illustrated. 5c. from Superintendent of Documents.

MINERS' SAFETY AND HEALTH ALMANAC, 1919—Compiled by R. C. Williams, Assistant Surgeon, U. S. Public Health Service. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 48; illustrated.

Among other subjects, takes up communicable diseases and general health of miners, water-supply, garbage and sewage disposal and has seven pages on sanitary privies, with illustrations. 5c. from Superintendent of Documents.

MUNICIPALITIES AND COUNTIES OF CALIFORNIA: Annual Report for 1917 of Financial Transactions. John S. Chambers, State Controller. Sacramento, Cal.: The Controller. Paper; 6 x 9 in.; pp. 219.

NATIONAL BRICK MANUFACTURERS' ASSOCIATION: Report of 32nd Annual Convention—Indianapolis, Ind.: The Association. Paper; 6 x 9 in.; pp. 192.

NATURAL GAS: Its Production, Service and Conservation—By Samuel S. Wyer, Columbus, Ohio. Washington, D. C.: Smithsonian Institution. Paper; 6 x 9 in.; pp. 67; illustrated.

PROBLEM OF STREET CLEANING, ROCHESTER, N. Y.: Report Submitted to the Mayor and to the Commissioner of Public Works. Rochester, N. Y.: Rochester Bureau of Municipal Research, Inc. Paper; 6 x 9 in.; pp. 133; illustrated.

This thoroughgoing study of local street-cleaning methods and needed reforms follows a similar investigation and report on snow removal, and will be followed in turn by a report on refuse collection. The street-cleaning study was made by John T. Child, assistant engineer, working under James W. Routh, chief engineer of the bureau named, and the report was written jointly by the two and finally edited by L. E. Snyder, director of the bureau. It is a good example of the excellent work being done by the best bureaus of municipal research.

THE REGULATION OF PRIVATE WATER COMPANIES IN NEW YORK CITY—By Delos F. Wilcox, Ph.D., [lately] Deputy Commissioner of Water-Supply, Gas and Electricity, City of New York. New York: The Author. Paper; 6 x 9 in.; pp. 24.

RECREATION USES ON THE NATIONAL FORESTS—By Frank A. Waugh, Collaborator; 1918. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 43; illustrated.

REPORT OF WATER RIGHTS BRANCH OF THE DEPARTMENT OF LANDS, PROVINCE OF BRITISH COLUMBIA, for 1917. The Hon. T. D. Pattullo, Minister; William Young, Comptroller. Victoria, B. C.: The Department. Paper; 7 x 10 in.; pp. 58; illustrated.

A report on water power and water-supply in the several districts of the Province of British Columbia; including a table giving revenue for the year and records of precipitation from various meteorological stations. The appendices give a list of 270 power sites of 500 hp. and over, of which 30 are wholly or partially developed, 93 sites applied for, and 147 known and unstaked; also instructions on how to acquire license to take and use water. There are also included data useful in measurement of water and the design and operation of water-supply structures.

THE SAFETY MOVEMENT IN THE IRON AND STEEL INDUSTRY, 1907-17—By Lucian W. Chaney and Hugh S. Hanna. Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 299; illustrated.

TABLES AND OTHER DATA FOR ENGINEERS AND BUSINESS MEN—Compiled by Charles E. Ferris, B. S., Professor of Mechanical Engineering, University of Tennessee. Knoxville, Tenn.: The Author. Leather; 3 x 6 in.; pp. 230; 50c.

SEWAGE DISPOSAL—By Leonard P. Kinnicutt, Late Director Department of Chemistry, and Professor of Sanitary Chemistry in the Worcester Polytechnic Institute; C. E. A. Winslow, Professor of Public Health in the Yale School of Medicine and Curator of Public Health in the American Museum of Natural History, New York, and R. Winthrop Pratt, Consulting Engineer, M. Am. Soc. C. E. Second Edition, Rewritten. New York: John Wiley and Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 547; illustrated. $4.

THE SHIPBUILDING INDUSTRY—By Roy Willmarth Kelly, Director, Harvard Bureau of Vocational Guidance, Author of "Hiring the Worker," and Frederick J. Allen, Assistant Director, Harvard Bureau of Vocational Guidance, Author of "The Shoe Industry;" with an Introduction by Charles M. Schwab. Boston and New York: Houghton, Mifflin & Co. Cloth; 6 x 9 in.; pp. 303; illustrated. $3.

STATE ENGINEER OF WYOMING: Report for 1917-18—By James B. True, State Engineer, Cheyenne, Wyo.: The Author. Paper; 6 x 9 in.; pp. 256.

Material on surface waters of Wyoming, with gaging records, occupies 154 pages.

STATISTICS OF COMMON CARRIERS: A Preliminary Abstract Dec. 31, 1917—Washington, D. C.: Bureau of Statistics. Paper; 9 x 12 in.; pp. 75.

SUMMARY OF SOLDIER SETTLEMENTS IN ENGLISH-SPEAKING COUNTRIES—Elwood Mead, Consulting Engineer, U. S. Reclamation Service. Washington, D. C.; Department of the Interior. Paper; 6 x 9 in.; pp. 27.

WAR ADMINISTRATION OF THE RAILWAYS IN THE UNITED STATES AND GREAT BRITAIN—By Frank Haigh Dixon, Professor of Economics, Dartmouth College, Chief Statistician, Bureau of Railway Economics, and Julius H. Parmelee, Statistician, Bureau of Railway Economics [Preliminary Economic Studies of the War, Carnegie Endowment for International Peace]. New York: Oxford University Press. Paper; 7 x 10 in.; pp. 155. $1.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Proposes Definition of Engineering

Sir—During some committee work, drafting a proposed registration law for the State of Michigan, it appeared desirable to include a definition of the term "Engineering." The writer submitted the following:

"Engineering is the ingenious application of the principles of science to the economical production and use of materials and energy."

It was suggested that the word "ingenious" was insufficient and that "judicious" should be coupled with it.

Would you like to try this definition on your readers?

E. M. WALKER.

Michigan Central R.R. Station, Detroit, Mich.

Honor American Engineer by Election To L'Institut de France

Sir—In your issue of Jan. 16, 1919, p. 162, there appeared a short notice concerning the election of Dr. J. A. L. Waddell to L'Institut de France in the Académie des Sciences. In view of the fact that he is the first American practicing engineer ever taken into that scientific body, or even into the Institute itself, and that the election was stated by high French authority to be intended as "a new expression of the gratitude which we (the French people) owe to your great nation," it seems to me that the occurrence is worthy of more than a perfunctory or passing notice.

Few Americans recognize that the French Academy of Sciences is the most select body of scientific men in the world, and that admission to its ranks is truly the highest honor to which any scientific man can attain. As proof of this, I repeat the fact stated in your notice that the resident membership is limited to 66 and the corresponding membership to 116. One could compile from its roster a long list of the world's best known scientists who have lived during the past 125 years, such as: Sir David Brewster, the Scotch physicist; Robert W. Bunsen, the chemist who invented the gas burner that bears his name; Sir William Crookes, the famous English physicist; James Dwight Dana, the well known American scientist; Charles R. Darwin and Sir George H. Darwin, father and son, of worldwide fame; Sir Humphry Davy; Sir Michael Faraday; Sir Edward Frankland, the well-known scientist; Asa Gray, the former dean of American botanists; Herman L. F. von Helmholtz, the eminent German physicist; Sir William and Sir John Herschel, father and son, the famous English astronomers; Baron Friedrich H. A. von Humboldt, the explorer; Thomas Henry Huxley, the English physicist and writer; Lord Kelvin (previously Sir William Thomson) the great Irish scientist; Samuel P. Langley, the American aëronautical expert; Pierre S. de Laplace, the prominent French astronomer; Count Ferdinand de Lesseps, the canal builder; David Livingstone, the African explorer; Elie Metchnikoff, the Russian physician; Fridtjof Nansen, the Arctic explorer; Louis Pasteur, the eminent French chemist, and James Watt of steam-engine fame.

I therefore take the liberty of bringing to the notice of your readers the great compliment which has been conferred upon the American nation, the engineering profession of this country, and one of its well known members.

JOHN LUNDIE,
New York. Consulting Engineer.

These Engineers Also Served

Sir—In this post-bellum period, when War Department and other Government officials are bestowing crosses, honors and "lime wash," and each and every department or branch of the "service" is being boosted for its efficient and marvelous contribution toward the victory, I bespeak your attention and offer a word in behalf of those *engineers who did not wear a uniform*, but who contributed their energy and brains to the common cause.

The results accomplished in the production of camps, cantonments, Army and Navy bases, warehouses, and war industry plants, are in no small measure attributable to the patriotic and untiring efforts and energy of civilian engineers, who have for the past twenty months devoted their time and organizations to the Government's needs.

For a civilian to fit himself into a military organization, where red tape and ancient civil-service methods delayed the machinery, required no small amount of adaptability and an unlimited amount of resourcefulness and diplomacy. The problem was made all the more difficult because of the fact that many of the Government contractual officers were men recently commissioned from civil life, who in turn were equally ignorant of the operation of the newly constructed war machine.

It is to the everlasting credit and renown of the civilian engineers that they met the situation squarely and produced results. From rodmen and draftsmen to supervising and consulting engineers they one and all worked toward a common end, and it is for these, unhonored and unsung, who wear no service stripes or insignia, but who did their bit, I write these lines.

These same men will now be turning their thoughts and energies toward the country's construction and industrial problems, and with the same adaptability, ripened by experience, they will meet the new problems and solve them.

P. H. NORCROSS.

Washington, D. C.

A Fair-Compensation Form of Contract

Sir—Considerable discussion has appeared in the columns of your paper regarding different types of fair-compensation contracts. It may, therefore, be of interest to some of your readers to take note of a type of contract on the basis of which bids were asked recently by the Sebastian bridge district, Fort Smith, Ark., for a reinforced-concrete bridge across the Arkansas River, to cost approximately $550,000.

The bridge district first asked for a lump-sum bid

based on certain quantities with unit prices to be used for additions or reductions in such quantities. As an alternative, the board also asked for a bid as follows: Under item 1 the contractor should name a lump sum to represent the total cost of the work, including fair overhead, administrative charges, freight, transportation of men, labor cost, material cost, etc.; second, an additional sum to cover the contractor's profit and the use of all machinery required for the proper execution of the work.

It was further stipulated that any saving effected in item 1 would be split 50-50 between the contractor and the bridge district. In the event of the cost being in excess of the first item, the second item, or fee, would be penalized for such excess up to an amount equal to two-thirds of such fee.

This gives the contractor every incentive for economical work on a profit-sharing basis; gives the owner every right to assume that a reasonable loss might occur, as against the original estimate, without affecting the cost to him, and also protects the contractor from loss due to unforeseen contingencies, as he can so work out the fee item that he will still receive enough to compensate him for depreciation of outfit and use of money.

This form of proposal was worked up by Hedrick & Hedrick, consulting engineers, of Kansas City, Mo.

N. F. HELMERS,
Siems, Helmers & Schaffner, Contractors.
St. Paul, Minn.

Engineers' and Artisans' Pay

Sir—With further reference to the matter of engineers' salaries in comparison with those of other skilled artisans, the following announcement by the local unit of the bricklayers, masons and plasterers' union, published in a local newspaper, may be of interest:

"On and after Apr. 1, 1919, the scale of wages of this union shall be $1.25 per hour, excepting on all hollow-tile and cement-block work, which shall be at the rate of $2 per hour, excepting partitions, which shall be at the rate of $1.25 per hour. All concrete construction and other artificial masonry shall be under the direct supervision of a member of the B. M. & P. I. U."

Transitmen on municipal work here, competent to act as inspectors, receive $100 per month.

J. H. GILES,
Pocatello, Idaho. City Engineer.

Hand Hammering of Concrete Forms Not New

Sir--Referring to the editorial in *Engineering News-Record* of Jan. 23, 1919, p. 169, entitled,, Hammering Forms a Useful Development in Concrete," I wish to say that while mechanical hammering of forms in order to improve density of concrete may be a new idea with the shipbuilders, the use of hand hammers for that purpose is not new.

In the construction in 1907 of the U. S. Grant Hotel, at San Diego, Cal., then considered the largest reinforced-concrete building in the world, a special "mallet gang" was organized, with orders to keep up a continual hammering against forms while the concrete was being placed; particularly against the form for the exterior of the building, which was all of concrete in elaborate detail. It was only by hammering that we could successfully fill all moldings and eliminate the air bubbles on the wall surfaces which left unsightly holes.

In the construction of the Timken office building in San Diego the next year, we used this same method with particular success in placing concrete for the many office partitions. They were of concrete 2 in. thick, reinforced with ½-in. steel rods. It was only by continual hammering that we could insure a complete permeation of concrete in the narrow forms.

The writer makes no claim to having introduced this method on these buildings, with which his connection was that of superintendent for the architect. In his own mind he has always given credit for the idea to the organization of Carl Leonardt, contractor for the U. S. Grant Hotel building 12 years ago. CARL REGER.
Morgantown, W. Va.

Shall We Have a Trade Union of Professional Engineers?

Sir—That the wages of engineers have lagged behind those of tradesmen because of lack of organization, as R. N. Atherton sets forth in his letter on p. 201 in your issue of Jan. 23, few will question. But is the remedy one of expediency through a union affiliated with the American Federation of Labor? Is engineering a trade to be classed with the "other trades?" Most engineers consider engineering a profession, and feel that as members of the profession there is no place for them in the ranks of organized labor.

The outstanding characteristic of union labor is selfishness. It tries to get what it wants by threats, intimidation, the application of force, and exhibits its force by strikes. A professional man is one who makes his living by means of education, primarily by the exercise of mental rather than physical effort. In addition, altruism is one of his characteristics. Furnishing a background to the more immediate and personal need of wages is the constructive work that calls for imagination, and, above all, service to the public, to one's fellow men. These are the problems of a profession.

The engineering profession is at the point of choosing the kind of organization it will have for collective effort. The American Institute of Architects, the American Medical Association, the bar, and the Chamber of Commerce are the types engineering organization will parallel. Such is the American Association of Engineers.

It is proper here to say that the efforts of the American Association to raise the pay of the technical engineer in railroad employ have been successful, much beyond our early hopes. New schedules have been put into effect on many roads, and others will follow. An assistant secretary was employed Feb. 1 to devote his time to the railroad field. A conference of railroad men will be held in Chicago Mar. 17 to discuss problems of an economic nature affecting their welfare.

Engineers must do a little housecleaning in order to be a profession, as did the doctors in eliminating the quacks. The answer is licensing. The American

Association of Engineers has been active in licensing and will devote most of the next issue of the *Monad* to this subject. After the housecleaning—after the standards of the profession are raised—we can give attention to the many constructive social problems challenging our best endeavor.

Since your correspondent invites engineers to join the union, it would seem proper that this new business organization of professional engineers should be brought to their attention through your columns. The choosing can be safely left to the individual engineer.

C. E. DRAYER,
Secretary, American Association of Engineers.
Chicago, Ill.

High Authority Restricts the Engineer

Sir—Referring to your editorial "Not Only by Their Works Shall Ye Know Them," in *Engineering News-Record* of Jan. 30, 1919, p. 215: Governor Smith has ample precedent for his disregard of the engineer in the new state reconstruction commission. Read President Wilson's reply to the suggestion of the Engineering Council that an engineer be appointed on any prospective national reconstruction commission: "You may rest assured that I realize what a service engineers can render in reconstruction problems from time to time."

You will note the emphasis of "can" and "from time to time." As permanent members of such a commission they are not to be considered.

M. S. PARKER,
St. Marie's, Idaho. Consulting Engineer.

Using Series of Uniform Loads To Obtain Maximum Stress

Sir—The principle of the diagram for fixing the position of a series of uniform loads to produce maximum stress, described by Mr. Christensen in your issue of Dec. 26, 1918, p. 1193, was discovered and applied by the writer in computing the stresses in a spandrel braced two-hinged arch, while associated with Mr. Christensen in work on the Niagara River Bridge.

A careful check was made of stresses obtained from an equivalent uniform engine load with those from corresponding wheel loads computed with the transparent scale described by Dr. Steinman in *Engineering Record* of Apr. 24, 1915, p. 517. The computation of stresses from wheel loads with Dr. Steinman's scale was found to be extremely tedious when compared with the use of the writer's diagram in connection with Mr. Christensen's equivalent uniform loading. The time required by the former method was fully four times as great since, owing to the curved and irregular shape of the influence lines, no criterion is available for determining the position of the train to produce maximum stress. This must be determined in practically all cases by trial.

A comparison of results obtained from Dr. Steinman's "Chart of Equivalent Uniform Loads" (see *Engineering News* of Apr. 22, 1915, p. 780), with those from Mr. Christensen's loading, for several examples of curved influence lines, varying in length from 230 to 600 ft., indicates that the errors resulting from the use of Dr. Steinman's chart are approximately double the errors resulting from the use of Mr. Christensen's loading. The maximum error found by the former method was approximately 5 per cent., while with the latter method it was about 3 per cent., compared with results from corresponding wheel loads. With either method it is necessary to compute the influence areas accurately and the amount of labor and the chance for mistakes are practically the same.

In designing long-span structures with curved or irregular influence lines, the loading and diagram described by Mr. Christensen may be used with facility equal to that of any other method heretofore employed; the results more closely approximate those determined from wheel loads than with any other method, and the time required is only a small fraction of that required in using wheel loads.

J. H. FLYNN,
Superintendent of Construction, Burroughs Adding Machine Company.
Detroit, Mich.

Camp Sanitation in India

Sir—The article by Harry N. Jenks in your issue of Jan. 23, 1919, on sanitation at the Namtu camp of the Burma Mines, Ltd., is of much interest to me and doubtless to others with experiences in the Far East. For many years in all parts of the Far East under British control, where large or small bodies of coolie labor have been employed, sanitary regulations similar to those described by Mr. Jenks have been rigidly enforced.

Some years ago I had much to do with coolie labor (Malabar or Tamil), and saw these regulations in full operation and was held responsible for their enforcement. Full reports have to be made to the Government authorities, and assessments periodically paid to the "District Medical Aid" for the upkeep of the local hospitals and dispensaries and of the district European doctor (medical officer in charge) and his very capable native or Eurasian local assistants. I can truthfully say that the coolie "lines" or quarters on all construction operations were cleaner than many of the streets of Philadelphia are today.

To most people in the United States, India is a sealed book. Few knew of its teeming millions of industrious workers, skilled in all manner of crafts and arts for many ages. It is an interesting part of the world for an engineer to visit. He will find colossal reminders of magnificent engineering works—full evidence of a very high order of civilization and constructive capacity—in India, Ceylon and Burma.

Mr. Jenks mentiones the native contractors. I have had native masons, Tamils from Madras, and men from Canara and elsewhere, do the best of work. My experience with carpenters, chiefly Singalese, has been equally satisfactory, and the native blacksmiths and machinists of various other races "caught on" very quickly. Common coolie labor usually works on a task system. Everything is done by the job.

Mr. Jenks' article is very interesting. To those who have been in the Far East and have not yet been able to cast off its fascinating spell it is like a memory of old times.

GEORGE HARPER.
New York City.

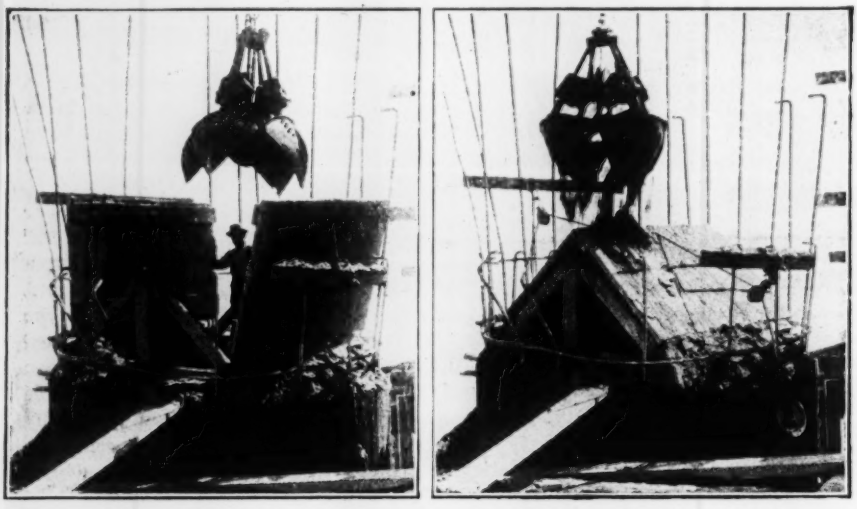
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Trap Door Aids in Excavation of Cylinder Foundation for High Tower

SPOTTING a clamshell bucket in the comparatively narrow opening of a concrete cylinder foundation is no easy job in the prevailing high winds of the St. Lawrence. As shown in the accompanying view of the tower foundations of the new 4801-ft. transmission line over the St. Lawrence River, recently built by the Shawinigan Water & Power Co. (described on p. 383 of this issue), difficulty was avoided by the construction of a trap door with inclined sides which avoided any movement of the derrick boom.

The device was invented by the foreman of the work, Thomas Burham. Before the trap door was put on, the excavating procedure was, first to spot the derrick boom right over the cylinder, then to lower the bucket, pick up a load, and dump the material by swinging the derrick. On account of the high winds always encountered in the valley, it was found rather difficult for the hoist runner to stop the boom directly over the opening, but by means of the trap door it was possible to keep the boom guyed in the same position during the excavation of one cylinder. All that was necessary was to lower the bucket, pick up the load, close the trap door, and dump the material directly on top of the door. It would then by gravity slide off and deposit itself around the cylinder. The doors were then opened and the procedure was repeated.



TRAP DOORS ALLOW BUCKET TO DIG IN CYLINDER AND TO DUMP CLEAR

Other Articles in This Issue of Interest to Contractors:

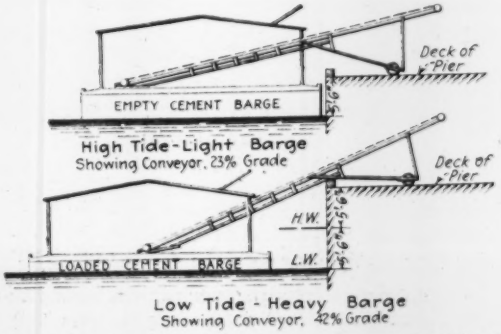
Concrete Material for Army Base Hauled by Motor Trucks — Page 366

Material Prices Halt Chicago Building Operations — Page 369

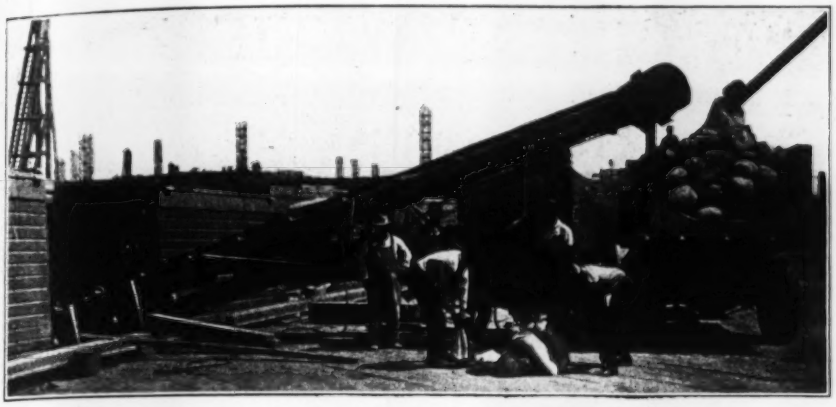
System Without Red Tape Makes Success of Day-Labor Road Maintenance — Page 384

Special Belt Conveyor Saves Time in Unloading Cement Barges

CEMENT was rapidly unloaded from barges at the South Brooklyn Army supply base by means of a specially designed belt conveyor. The special truck body shown in the illustration held about 110 bags, and could be filled in from 8 to 10 min. A battery of six of these machines, which is shown in operation in an article on p. 366 of this issue, was kept busy in the height of the construction season unloading sufficient cement to supply the mixing plants. Being substantially constructed and supported under the engine box with wheels, it could be easily moved from one location to another, according to the places where the boats docked. The length of the device was 45 ft. There were 22 upper rollers, about 6 in. in diameter, 6 return rollers 6 in. in diameter and two end rollers of about 16-in. diameter. The belt which traveled over the rollers was 24 in. wide. A 10-hp. gasoline motor supplied the power. A 15-hp. motor is recommended for this work, so as to increase the speed on steep grades. The truck body shown was originally constructed to haul bulk cement which it was originally intended to use on this job. As this was not found practicable, the trucks were used for bagged cement. The interiors were shaped, made narrower at the forward end and lined with sheet steel, so that when the truck



DEVICE GIVES CLEARANCE AT HIGH AND LOW TIDE



TRUCK BEING LOADED FROM SCOW WITH BELT CONVEYOR

ended up all cement would flow readily from the body.

As stated, this type of body was designed for bulk cement and was used on only a few trucks. Bagged cement dumps readily from ordinary boxes.

Six men were required to throw on the bags at the lower end of the conveyor, while one man arranged the bags on the trucks. When it was necessary to move, these were sufficient to pick up the initial end and wheel the device to the new location. The sketch shows how clearance was obtained at high and low tide and with loaded and empty barges.

The work was done under the supervision of the Construction Division of the Army. Brig.-Gen. R. C. Marshall, Jr., is chief of the Construction Division, Lieut.-Col. H. F. Crocker is constructing quartermaster, and Maj. George Perrine, Quartermaster Corps, National Army, is directly in charge of this part of the work.

The general contractor is the Turner Construction Co., of New York City, of which A. C. Tozzer is executive manager.

Quantity Production of Officers' Huts By Erection of Framed Units

CONSTRUCTION of 698 huts, 20 x 20 ft., for the extension to Camp Custer, was facilitated by the erection of ends and sides as completely framed units. A sample hut was built, and a duplicate was made of each piece of lumber entering into the building. These duplicates were set aside as patterns and jigs were set up from them, so that all the cutting for the huts was done at a mill centrally located. Platforms, later used as hut floors, were erected and made into templets for framing the four sides. When framed, the hut sides were piled like on like, and tractor-hauled wagons took four sides as a load to the hut site. Foundation gangs built the floor platforms. Then the erection gangs set up sides and ends and placed the roof, all lumber for which had been cut to dimensions at the mill. This operation completed the outside of the building, except doors and windows. Finishing gangs completed the buildings. The Camp Custer extension was constructed by the W. E. Woods Co. contractors, of Detroit, Mich.,

SIDES AND ENDS ERECTED AS FRAMED UNITS

under the direction of Maj. T. A. Leisen, constructing quartermaster, and Samuel A. Greely, supervising engineer.

SIDES AND ENDS FRAMED ON TEMPLET PLATFORMS

Costs at Los Angeles Municipal Asphalt Plant

During the fiscal year which ended June 30 the municipal asphalt plant at Los Angeles turned out 634,860 cu.ft. of mixture, according to the annual report of the Engineering Department of the city. This covered nearly all the standard asphaltic surfacings, and the cost per cubic foot ranged from 13.03 to 15.88c., the average being 15.6c. These figures represent an increase in cost over those of 1916-17 of approximately 19%, which is attributed to higher prices of labor and material. The plant was designed and built by the Engineering Department, and the cost, including additions to the original structure and equipment, amounts to $28,625.

NEWS OF THE WEEK

New York, February 20, 1919

Associated Contractors Appoint Acting Secretary

At a meeting of the Executive Committee of the Associated General Contractors of America, held in Washington, Feb. 10, it was decided to engage G. W. Buchholz, recently works manager for Fred T. Ley & Co., Inc., New York City, as acting secretary of the association, with the duties of executive manager. William A. Davis, recently of the War Labor Board, was selected to act as organization manager to assist the secretary.

Would Reimburse Contractors For Their War Losses

Minnesota cities of more than 50,000 population will be authorized to reimburse contractors on municipal work for losses on account of war conditions, if a bill that has been introduced in the legislature becomes law. While general in character, the bill is aimed to make good the losses said to have been incurred by the contractor for the new concrete reservoir for the water department of St. Paul. (See *Engineering News-Record* of Jan. 9, 1919, p. 96.) This contract was awarded for $247,000 about four months before the war. It is said that the company figured on labor at $2.25 per day, but had to pay $4 before the work was finished, and had to meet a corresponding increase in prices for materials. Under the city charter of St. Paul the city could not reimburse the company for such losses. The bill is backed by the city authorities of St. Paul, and has been indorsed by the building trades labor organizations of the city.

Dealers, Not Manufacturers, Lower Cement Prices

In the "Construction News" Section of *Engineering News-Record* of Jan. 30, 1919, p. 51, last column, it was stated that portland cement in New York had been reduced from $4 at dock in cargo lots to $3.45. It was not made clear, however, that this reduction was made by the dealers and not by the manufacturers. The price of cement at the mill remains the same; the reduction is a reduction in profits which the dealer is content to take.

Owners Refuse Government Offer For Cape Cod Canal

Pursuant to recent legislation, the Secretaries of War, Navy and Commerce have met and considered the desirability of the Government purchasing the Cape Cod Canal. As they decided that the purpose was desirable, the next step was for the Secretary of War to negotiate the purchase. Accordingly, after investigation and appraisal, he offered the owners $8,250,000 for the property. This offer was declined, and, still pursuant to the law, the Secretary of War then asked the Attorney General to begin condemnation proceedings.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western Zone, 63 E. Adams St., Chicago.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Meyers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

No Federal Public Works Department Bill This Session

According to a note in the Washington papers, Senator Kenyon of Iowa has abandoned hope of getting through this session of Congress his bill providing for an emergency department of public works. In lieu of this bill he has introduced a bill to create a joint Congressional executive commission of six to inquire into existing methods of financing the construction and acquisition of homes within the reach of people with modest means.

John Fritz Medal Awarded to General Goethals

The John Fritz Medal Board of Award Committee, composed of representatives of the four national engineering societies, at its annual meeting on Jan. 17 awarded the John Fritz medal to Maj. Gen. George W. Goethals.

Government Surplus Building Material Small

Inventories of All Army Construction Projects Show Relatively Little That Cannot Be Absorbed

Building material on hand for Government work will probably not become available for private use in any great quantity, nor will its disposal cause much disturbance of the market. The War Department has just made an analysis of the surplus material in the hands of the Construction Division—which has probably 90% of all building material in the department and certainly the greater part of all material held by the Government—and as a result announces that most of the surplus will be absorbed in other Government work. The inventories, as of Dec. 31, are divided into the following main groups: Lumber, plumbing and heating, electrical material and equipment, cement, wallboard, millwork, roofing, screening, etc.; miscellaneous building material, steel, nails, bolts, nuts and washers, building hardware, paints and oils, railroad material, paving material, piling and poles, raw material, fencing, belting, cable, etc.; chain, dynamite, caps, etc.; fuel, hose, harness, etc.; lanterns, flashlights, etc.; rope, and miscellaneous. The total cost to the Government of the above materials is approximately $12,000,000. In addition, there are construction equipment, office equipment, small tools, etc., amounting to approximately $3,500,000.

Large quantities of the material are being consumed inside the War Department, the Construction Division alone having made, since Dec. 31, 800 transfers of materials which were declared surplus at one project or another, transferring them to some project where work was being completed. Approximately $2,000,000 worth of building material has been absorbed in this manner, and the transfers still continue.

The War Department is making no purchases where material can be obtained from some other project. The largest single item in the above summary is lumber, representing approximately one-half the total. A contract for this has been made with the producers, and it will be distributed to the market at market prices.

At each of the 476 Army projects there is a constructing quartermaster, who will make sales of his own surplus under general instructions issued from the director of sales. This means that the majority of this surplus will be absorbed in the particular locality in which it is situated.

Annual Convention of Engineering Institute of Canada

Standardization of engineering parts and the electrification of railways were subjects of technical interest at the annual convention of the Engineering Institute of Canada, held in Ottawa, Feb. 11-13, with an attendance of about 300 members, including several prominent engineers from the United States. The war accomplishments of Canadian engineers and the development of munition work in Canada were outlined by the president, H. H. Vaughan, of Montreal, who stated that the institute was represented overseas by 960 of its members, being 36% of the total.

"Standardization in Engineering" was the subject of a paper by Capt. R. J. Durley, chief of the Division of Gages and Standards, Imperial Munitions Board, who described the work of standardization in engineering parts carried on in England and the United States. He urged international standardization, especially in airplane parts.

A long and interesting discussion on the subject of good roads followed a paper on the subject by Capt. J. Duchastel, who advocated an appropriation of $50,000,000 by the Federal Government to aid the provinces in constructing highways of national importance. Dr. Ira S. Hollis, representing the American Society of Mechanical Engineers, delivered an address in which he expressed the cordiality of the relations between the United States and Canada, and A. D. Flinn, secretary of the Engineering Council, discussed "International Affiliation of Engineers."

The principal feature of the third day's proceedings was the presentation and discussion of papers on the topic of "Railway Electrification," by John Murphy, Ottawa; W. G. Gordon, transportation engineer of the Canadian General Electric Co., Toronto; F. H. Sheppard, director of heavy traction, Pittsburgh, Penn., and Comfort A. Adams, president of the American Institute of Electrical Engineers. This subject was treated comprehensively, presenting the advantages in the adoption of electrical equipment by the railways.

The new officers elected include Lieut. Col. R. W. Leonard, St. Catharines, Ont., president; Walter J. Francis, Montreal, and D. O. Lewis, Victoria, B. C., vice presidents.

Engineer Heads Housing Bureau

L. K. Sherman, of Chicago, has been made director of the Bureau of Industrial Housing and Transportation of the United States Department of Labor, succeeding Otto M. Eidlitz, who has resigned. Mr. Sherman is a sanitary engineer who has been connected with a number of the public works in and around Chicago, notably the Chicago Sanitary district. He has been serving as assistant chief engineer of the housing bureau throughout the war.

Canadian Government States Federal Road Policy

Plan Described at Meeting of Eastern Ontario Good Roads Association—Other Convention Action

Announcement of the Federal road policy of the Canadian Government was made by a representative at the annual meeting of the Eastern Ontario Good Roads Association, held at the Chateau Laurier, Ottawa, Feb. 4 and 5. The national, and even the international, importance attached to this Government statement made it one of the outstanding features of the meeting.

In giving out the information at the annual dinner, the Hon. Dr. J. D. Reid, Federal minister of railways and canals, whose portfolio includes the Department of Highways, stated that of the 250,000 miles of highways in the Dominion of Canada 200,000 miles are third-class roads leading from the farm to the market; 40,000 are second-class roads leading from the larger centers to smaller market centers, while the remaining 10,000 miles are first-class roads connecting the larger centers of population in the provinces.

The Dominion Government, according to Dr. Reid, agrees to pay an amount toward the cost of first-class roads which will be fair and reasonable. No definite statement regarding the amount was made, but it is believed that it will be either 40 or 50% of the total expenditure. The Hon. Gideon Robertson, minister of labor, suggested that in laying out work care should be exercised that the highways be near larger centers of population where unemployment exists.

In discussing the Federal announcement, the Hon. Findlay McDiarmid, minister of public works and highways for the Province of Ontario, stated that it would result in his department designating a greater mileage of provincial highways and would mean more rapid construction. Ontario had passed suitable legislation two years ago. There had been criticism in certain quarters regarding trunk-highway construction under present conditions, and he asked whether the convention favored delay. A negative answer appeared to be unanimous. He said that if ever a progressive program was justified it is now, and it would be the endeavor of his department to build the roads in such a way that they would meet future as well as present demands.

Since its formation in July, 1918, the Good Roads Association has promoted 195 miles of provincial highways, and 331 miles of county provincial highways have been arranged for. This system will connect Ottawa and Prescott, Ottawa and Kingston and Ottawa with the Quebec Highway leading to Montreal.

Nearly 300 delegates were registered during the convention, and the officers elected were as follows: President, Nelson D. Porter, Ottawa; secretary-treasurer, W. Y. Denison, Ottawa.

Highway and Truck Appropriations Agreed to by Conferees

Conferees of the United States Senate and House have agreed upon the Post Office Appropriation Bill, including $200,000,000 for Federal aid to highways and $300,000 to continue experiments with motor-truck transportation of parcels post mail matter. The bill also increases the number of roads to which Federal aid may be applied.

Michigan Plans Extensive Highway Improvements

A bill has been passed by both houses of the Michigan legislature, providing for submitting to the voters, a constitutional amendment which will allow the issue of $50,000,000 in highway improvement bonds. An election for this purpose will be held early in April. Various state farmers' organizations, together with the Grange, have passed resolutions approving of the amendment.

It is proposed to complete a system of about 5000 miles of roads. Roughly speaking, this will comprise two north and south main lines from the southern boundary to Lake Superior, with the necessary cross-connecting lines to reach every county in the state. Arrangements are being made to introduce immediately laws to carry out the plan, if the people approve of the amendment. If present plans materialize the funds will be raised by taxation, each county paying a certain percentage of the cost of the highways within its boundaries, while the remainder will be paid by the state as a whole.

Highway Bond Issue Approved by Minnesota Legislature

Practically unanimous approval of the plan to submit to the people an amendment to the state constitution, providing for a bond issue to construct a definite state highway system, was given recently by both houses of the Minnesota legislature. There were only 10 votes against the plan—three in the Senate and seven in the House—and they were all cast by members of the Nonpartisan League, apparently for political reasons. A complete description of the proposition was given in *Engineering News-Record* of Dec. 26, 1918, p. 1199. The amendment, which provides for the issue of not more than $100,000,000 in bonds, will be submitted to the people at the general election in 1920.

Building Officials Have Meeting

Men responsible for the administration of building laws met at the fifth annual Building Officials' Conference, held at Pittsburgh Feb. 6-8, 1919. A joint session of the conference and the National Brick Manufacturers' Association was held Feb. 7.

The placing of responsibility for safe building construction and a proper compliance with laws and ordinances formed the chief topic of discussion. It was generally agreed that effort should

be made to place that responsibility. The outcome of the discussion was the adoption of the following resolution:

Resolved, that it is the sense of the Building Officials' Conference that for the better protection of the public against unsafe and illegal building construction, suitable legislation should be enacted by which building operations shall be restricted to architects, engineers, builders, superintendents of construction or others who have by proper evidence shown their ability or capacity for undertaking such building operations, and on whom individual responsibility for the safe prosecution of the work and a compliance with the laws relating to buildings can be placed; and

Resolved, further, that the secretary of this organization be directed to furnish, at the request of any member, copies of this resolution for presentation to legislative bodies in support of such legislation.

Rudolph P. Miller, New York, continues as chairman of the conference and F. W. Lumis, superintendent of buildings, Springfield, Mass., is secretary.

Philadelphia Lets Contract for Big Pier

Philadelphia is the first big city actually to let a public works contract of any size. On Feb. 14 the Department of Wharves, Docks and Ferries opened bids for the construction of the Kenilworth St. pier on the Delaware River, a modern freight pier of the well-known Philadelphia type. Eleven contractors made tenders of remarkable closeness, considering the times. On Feb. 17 the contract was awarded to the F. W. Mark Construction Co., of Philadelphia, the low bidder, at $908,000.

The itemized bids are given in the pages of the "Construction News" section. Throwing out two in excess of $1,500,000, the remaining nine bids varied a maximum of $173,000 from the average, with seven bids less than $83,000 above the low bid.

The work comprises 200,000 cu.yd. of dredging, 800 tons of riprap, 30,000 tons of gravel and stone fill and 11,200 sq.yd. of paving.

Contract for Seven Miles of 72-Inch Steel Water Pipe To Be Let

Bids for furnishing and laying 34,590 ft. of 72-in. riveted steel pipe to duplicate the present water-supply conduit between the Boonton reservoir and the Watchung tunnel (near Upper Montclair) are wanted by Jersey City, N. J., until Mar. 25. The work was advertised in 1918, separate bids for furnishing and laying the pipe having been invited, but war conditions prevented letting contracts. Michael I. Fagen is director and Charles A. Van Keuren is chief engineer of the Department of Streets and Improvements, and Clyde Potts, New York City, is consulting engineer for the work.

More Engineers Get High Military Honors

Made Grand Officers of the Legion of Honor and Receive Distinguished Service Medals

High military honors were awarded to several engineer officers in Washington Feb. 13, when General Collardet, the French military attaché, formally presented decorations of the Legion of Honor, previously decreed by President Poincaré, and Secretary of War Baker, in the name of President Wilson, decorated nine American Army officers and two civilians with the Distinguished Service Medal.

Five officers were made Grand Officers of the Legion of Honor, including Maj. Gen. Henry Jervey (previously colonel, Corps of Engineers), Maj. Gen. George W. Goethals and Maj. Gen. William C. Gorgas.

Distinguished Service Medals were formally presented to a number of officers by Secretary Baker. The recipients of the medals included the following:

Brig. Gen. R. C. Marshall, Jr., chief of the Construction Division, for "his zeal, judgment and exceptional administrative ability in the Construction Division of the Army, which enabled serious difficulties to be overcome and the construction necessary for a great army to be provided."

Brig. Gen. Robert I. Rees, chairman of the committee on special training and education, for "his initiative and breadth of vision, to which were largely due the successful measures for training enlisted men for special services and the establishment of the Students' Army Training Corps."

Brig. Gen. William H. Rose, in charge of the Engineer Depot, who "while in charge of the Engineer Depot was charged with the system of purchase of supplies. His exceptional ability, judgment and resourcefulness are apparent in the efficient solution of the many difficult problems involved and in the success attained in supplying the vast quantities of engineering supplies to the Army overseas."

Distinguished Service Medals were also conferred on Guy E. Tripp, "who, as chief of the Production Division of the Ordnance Department, and later as assistant chief of ordnance, displayed fine technical ability and broad judgment in systematizing methods and practices, resulting in the efficient cooperation of industries producing articles of ordnance for the Army," and Edward R. Stettinius, "who, as Director General of Purchases for the War Department, Second Assistant Secretary of war and special representative in France of the Secretary of War, in connection with the procurement of munitions for the American Expeditionary Forces, rendered conspicuous services. His broad vision and splendid judgment have been of the greatest value to the success of the military program."

St. Louis Garbage Will Be Fed To Hogs for a Year

The garbage of St. Louis will be fed to hogs during the year beginning Feb. 15, 1919. Meanwhile, the Board of Public Service will prepare specifications, on broad lines, under which bids for disposal will be invited. During the present year the garbage from the outlying districts will be sold by the city to a number of hog raisers in St. Louis County, the city delivering the garbage at various stations within the city limits and the hog raisers agreeing to pay 25c. a ton for stated amounts. All the remaining garbage collected by the city will be bought by Guy Caron, Little Rock, Ark., for 25c. a ton, and will be delivered by the city to a hog-feeding farm to be established by the contractor within 50 miles of St. Louis. The city agrees to deliver a minimum of 150 tons in three days, and Mr. Caron agrees to take any amount in excess of the minimum. It is estimated that during the summer season the deliveries will be as high as 100 tons per day.

Transportation from the city to the Caron farm will cost the city from 25c. to 40c. a ton, according to the location finally chosen. Thus, for one-half to one-third of its garbage the city will get 25c. a ton, delivered, while for the remainder disposal will cost it from nothing to 15c. a ton. It is estimated that under the worst contingencies the average net cost of disposal for the year will be 5c. to 10c. a ton, which under favorable conditions there may be a small revenue to the city.

Until recently the city paid the Indiana Reduction Co. 87c. a ton for disposal by reduction, the contractor transporting the garbage, at its own cost, from loading docks in the city to its plant. This contract expired Sept. 1, 1918. The company then took the garbage without cost, the city towing it to the reduction works at an estimated cost to it of 20c. a ton. Under an option, the company cancelled this contract, the cancellation to take effect Feb. 15, 1919. All of the foregoing figures are exclusive of the cost of collection.

Portland Grain Elevator Settles During Construction

Settlement of the municipal grain elevator being built at Portland, Ore., has halted work on the structure while studies of the foundation conditions are being made. The building is of concrete, 155 x 111 ft. in plan and 85 ft. high. It is founded on a heavy concrete mat resting in turn on wooden piles 50 to 60 ft. long. It is estimated that these piles are now taking about 60% of their ultimate load. They were designed for a safe load of 25 tons per pile, and some of the piles were loaded with 40 tons without settlement. So far the observed settlement has been about 12 in. and is decreasing. It is not quite uniform, the floor being 4 in. out of level.

Proposes Extensive New York Port Scheme

Before the New York-New Jersey Port and Harbor Development Commission, Feb. 13, Gustav Lindenthal, New York consulting engineer, explained an extensive scheme for the development of the terminal and transportation facilities of the Port of New York which he proposes. The plan calls for a belt railroad in New Jersey tying together the railroads there and connecting with Staten Island, Long Island and Manhattan Island by bridges and tunnels. There would be a classification yard in the New Jersey meadows accessible to all railroads and to motor trucks, from which local freight to Jersey City and Manhattan could be distributed; a multiple-track, high-level bridge across the North River, an elevated railroad connecting with the bridge and paralleling the river water front in Manhattan, with freight and passenger stations and market halls distributed along its length. There would also be tunnels under the river near Battery Place, which would provide circulatory movement of trains to and from the New Jersey side. Further developments would be a tunnel under New York harbor, connecting the present Greenville yard of the Pennsylvania and the Bay Ridge yard of the Long Island, a union station in Manhattan Island for all of the railroads coming through New Jersey, connection via moving platform in a tunnel between all of the north and south rapid-transit lines and the belt-line railroad, and a tunnel connection between the river tracks of the New York Central and the tracks of the other divisions of the same railroad.

The plan proposed is but one of many which have been presented to the commission. It contains features similar to those proposed by William J. Wilgus and by Ernest P. Goodrich some years ago. The estimated cost of the project, not including river-front improvements and shipping piers, would be about $211,000,000.

Money for the California Land Settlement Board

For an extension of the work of the California Land Settlement Board, described at length in *Engineering News-Record* of Dec. 5, 1918, p. 1014, an appropriation of $1,000,000 from current revenue and a bond issue of $10,000,000, available two years hence, are proposed. It is expected that bills to those ends now before the legislature will be enacted. Dr. Elwood Mead, Berkeley, Cal., is chairman of the board.

Bills Call for Power Surveys

Requests for two appropriations for special investigations and report on the power supply have been made by Secretary of the Interior Lane. One of these asks an appropriation of $50,000 for a survey of the power resources all over the United States. This proposed appropriation is embodied in the Sundry Civil Bill. If approved, the work would be done by the Geological Survey. The other request is for an appropriation of $200,000 for a report on the power supply for the industrial region of the northern Atlantic seaboard, extending in general from Boston to Washington. If approved, this work would be done by the Geological Survey and the Bureau of Mines in cooperation. The request for the $200,000 appropriation has been approved by the Secretary of the Treasury and has been forwarded to Swagar Sherley, chairman of the House Committee on Appropriations.

Minnesota Engineers Meet In Joint Sessions

The annual meeting and banquet of the affiliated societies of the Minnesota Joint Engineering Board was held in St. Paul, Feb. 13. It was attended by over 200 representative members of the eight societies affiliated under the board. The speakers of the evening were Edward A. Filene of Boston, director of the Chamber of Commerce of the United States and member of the League to Enforce Peace committee, now touring the country with Ex-President Taft; L. C. Fritch, vice president and chief engineer of the Chicago, Rock Island & Pacific Ry., who spoke on the railway problem; Oscar Hallam, associate justice of the Supreme Court of Minnesota, who delivered an address on "The American Engineer"; W. L. Darling, director of the American Society of Civil Engineers, who spoke on the work of the Development Committee and the engineer's relation to public affairs, and Dwight E. Woodbridge, consulting mining engineer of Duluth.

Before the banquet a business meeting of the board was held at which two delegates from each of the affiliated societies were present and discussed various organization schemes which had been presented by the Engineers' Society of St. Paul, the Engineers' Club of Duluth, the Engineers' Club of Minneapolis and the Minnesota Section of the American Institute of Electrical Engineers.

There was a surprising unanimity of opinion that the Joint Board should continue as a joint board along the lines on which it had already been organized, with the exception that the membership of each society should be increased to three. As the board is organized at present, there is one member from each society, and the work of the board has increased to such a point that each member is carrying too much load. With 24 members, the work can be divided and much more effective service rendered. This body voted to make this change in the organization, and it was concurred in by the Joint Board in business session; this change in its constitution will be immediately presented to the various societies for confirmation.

Isolation Is Problem of North Dakota Engineers' Society

Although no bond issue for good roads is in sight in North Dakota, that state in 1918 put under construction more mileage bearing Federal aid than did neighboring states, according to J. E. Kaulfiss, assistant state highway engineer, who addressed the North Dakota Society of Engineers at the recent meeting held at Valley City. He stated that outside of towns and cities all road improvements consist of grading, shaping, weed extermination and bridge and culvert construction, which will be useful when surfacing becomes financially possible. County work, previous to the establishment of the State Highway Department in 1917, was carried out on the basis of $900 per mile, but already, by common consent and request of counties, the state has increased this to $1500. Of the 350 miles put under construction last season, one-half is complete. Funds and plans will be available for at least an equal mileage this year.

The surfacing of roads has not yet received any serious consideration, but Mr. Kaulfiss was of the opinion the demand would come sooner than most people expected, because of the fact that the state heads the list of persons per automobile, 9.3, with Nebraska next at 9.5. With another bumper wheat crop and unprecedented high prices, the farmers' demands will inevitably be in the direction of good roads all the year round.

In the address of the president, E. J. Thomas, professional difficulties due to isolation and the impracticability of having any but annual meeting activities were emphasized. Authorization was given for a committee to work out if possible some coöperative scheme with the American Association of Engineers whereby service might be rendered throughout the year. Prof. R. H. Slocum, who made the proposal, was of the opinion that a mutually beneficial arrangement could be effected. "Publicity for the Engineer and How to Get It" was the subject of an illustrated talk by W. W. DeBerard, who held that too few engineers utilized the opportunities for publicity of the work of the profession. Licensing of engineers and surveyors was discussed, and the question of standardized fees received attention, but no action was taken.

The officers elected for the coming year are J. A. Jardine, president; Miss E. M. Jack, city engineer, Williston, and R. M. Stee, vice-presidents; W. H. Robinson, state engineer, librarian; Prof. E. F. Chandler, University, secretary. Fargo won the contest for the meeting place next year.

Flood-Control Survey of the River Colorado Proposed

A survey of the Colorado River with a view to flood control is provided for by a bill now before Congress. The bill directs the Secretary of War to

make "a preliminary examination" of the river "with a view to the control of its floods in accordance with the provisions of an act to provide for the control of the floods of the Mississippi River and of the Sacramento River in California," approved Mar. 1, 1917.

Oregon Engineers Discuss Legislation

At the annual meeting of the Oregon Society of Engineers held in Portland on Feb. 3, a spirited discussion of the bill for registering professional engineers, now before the legislature of Oregon, was participated in by nearly everyone present. When a vote was called for, however, the majority was not willing to express a definite opinion for or against such legislation.

A bill abolishing the offices of county surveyor and roadmaster, and creating the office of county engineer in place of them, was indorsed by the society.

The election of officers resulted as follows:

President, John W. Cunningham, of Baar & Cunningham, consulting engineers; third vice president, to serve three years, O. Laurgaard, city engineer of Portland; treasurer, Henry M. Morse, consulting engineer; secretary, Orrin E. Stanley, sewer engineer, Department of Public Works, Portland; directors, to serve three years, Philip H. Dater, district engineer, United States Forest Service, Portland; O. A. Kratz, chief of the Bureau of Construction, City of Portland, and Herbert Nunn, state highway engineer, Salem.

Chief Engineer of Expeditionary Forces Gets Medal

Maj. Gen. William C. Langfitt, chief engineer of the American Expeditionary Forces, received the Distinguished Service Medal from General Pershing on Jan. 18 at headquarters, Services of Supply, at Tours. The decoration was conferred personally by General Pershing, the award being made for efficient conduct of the engineer department's work.

Notes from the Field

In the agitation for higher compensation levels there is danger that many will draw the conclusion that they will get higher pay when the levels go up, despite the quality of their services. Such a conclusion would be unsound. The higher the salary, the stricter the scrutiny in employing and retaining men. Moreover, there will always be the lower grades, no matter how high the general level may be raised. The rewards will go to the good draftsman, the good inspector, the good assistant engineer. The man who is just scraping through, giving an indifferent service, is going to remain in the lower ranks, while his more competent, reliable and conscientious brethren will get the increased compensation.

Take a case recently under observation. An engineer had been advanced in a year's time from the $3000 to the $4300 salary class, though for 10 years his salary had hovered around the $3000 mark. It was conceded that the cost of living and change of work warranted the increase. As a $3000 man no fault was found with his services. He had exercised relatively little initiative; the man above made the decisions.

In the $4300 class his work was subject to much more severe scrutiny. He had reached the class where initiative is demanded. He was expected "to come through big," and he failed.

It was not the employer's hope that he could get the assigned work done for less than $4300, but he knew that he could get mighty good men for $4000, and his duty to himself and his company demanded that he buy the best brains obtainable for the money available.

What applied in this case applies generally. No matter how the general compensation levels may rise, only those will rise with them who have corresponding capacity. The lower grades will always remain, as they do in medicine and the law. They will be filled by those less well prepared, less careful, less faithful.

Only those will rejoice in the coming day who are prepared to earn the higher compensation.

The incident related above suggests also that while it is easy to get a job the hard part is to hold it. E. J. M.

Council Urges Engineers for Reconstruction Committees

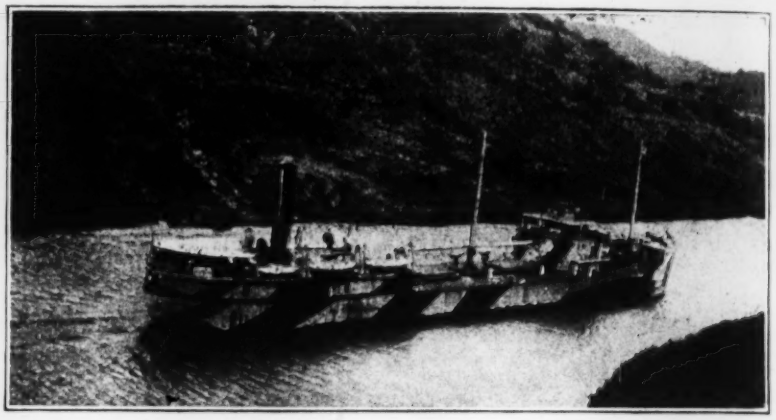
The chairman of the Engineering Council, J. Parke Channing, has sent to Governor Smith of New York and to all other Governors letters in which, after reviewing the serious situation in which many technical engineers now find themselves because of the cessation of work by private enterprise in engineering construction, says:

"Even if it is wise to defer actual construction till prices are more favorable, there is a wonderful opportunity now to make plans for the future." The letter urges the appointment at once of a reconstruction committee, a proper proportion of whose members shall be engineers of prominence, or, if such a committee has already been appointed, that carefully selected engineers be added to its membership, and continues:

"Highways, schoolhouses and other public buildings, water-works, sewerage systems and public utilities are among the public works which may be planned according to the needs of the state and its communities. Engineers are especially fitted to advise on projects of these kinds. It is suggested that even if at the present time lowest prices for materials and minimum wages may not yet prevail, it will in the long run be an economy to the state to utilize now the professional talent and labor available in making plans for the future, and in executing work which may be urgent."

Two Noted Engineering Achievements

The concrete freighter "Faith" passing through the Culebra Cut of the Panama Canal on its way north last fall. The photograph has been withheld until now by the censor.



Record Number of Students

As a result of the war, the Massachusetts Institute of Technology has more regular students than it ever had before at this time of year. The precise number is 1944—this in spite of the fact that practically the whole of the senior class has already been graduated by reason of special courses.

General Black Heads Federal Port Commission

Maj. Gen. William M. Black, chief of engineers, United States Army, has been made chairman of the Port and Harbor Facilities Commission of the United States Shipping Board, succeeding Edward F. Carry of Chicago, who recently resigned. General Black will continue to perform his military duties in addition to those devolving upon him in his new position. The Port and Harbor Facilities Commission is engaged in the study of the ports of the United States with a view to recommendations as to methods which will increase the use and economy of such ports. It has been in existence for six months or more, but has not as yet presented any public report.

Hydraulic Turbine Casing Breaks and Floods Power Plant

On Feb. 17 the cast-iron scroll case in the upper section of one of the hydraulic turbines in the Wachusett dam power station at Clinton, Mass., broke suddenly, leaving an opening about 12 ft. square. Before the flow could be shut off the escaping water had flooded the power station 4 ft. deep and pretty thoroughly destroyed the movable contents. The generating units themselves were not seriously damaged and require little except drying to put them in service. The total damage is estimated at $5000.

The break was caused by the sudden closing of a wicket gate, presumably by a governor. The flood prevented the operation of the hydraulic gate, and a watchman had to go to the top of the dam and shut off the flow by operating the hand gates in the upper chamber. This took about a half hour. Fortunately, all switches were pulled before the men left the power house, so the only damage was by the water.

The dam is a part of the Metropolitan Water Supply for Boston and the surrounding district.

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION: 150 Nassau St., New York City: Feb. 25-28, New York City.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago: May 13-14, Chicago.

ENGINEERING SOCIETIES

The Minnesota Surveyors and Engineers' Society gave a prominent place to a discussion of matters of legislation, at the annual meeting held at St. Paul Feb. 12-14. It was pointed out that resolutions passed by the society during the state legislature assembly had had apparently little effect, indicating personal effort with legislators by engineers as being the best means of bringing action in matters of interest to the engineering profession. Among the reports of committees were those on drainage, highways, and municipal engineering. The following officers were elected for the year: President, Harvey S. Dartt, city engineer, Mankato; vice-president, R. W. Acton, engineer of roads, St. Louis County, Duluth; secretary, C. H. Stewart, Department of Public Works, St. Paul, and treasurer, William C. Fraser, municipal engineer, St. Paul.

The Canadian Engineering Standards Association has been incorporated, with headquarters at Montreal, for the purpose of coördinating efforts of producers and users in the improvement and standardization of engineering materials, and promoting the general adoption of standards in connection with engineering structures. The incorporators are Sir John Kennedy, consulting engineer; Dr. Robert F. Ruttan, professor of chemistry; Dr. John B. Porter, professor of mining engineering; Richard J. Durley, engineer, and Henry H. Vaughan, engineer, all of Montreal.

The Vermont Society of Engineers will hold its annual meeting at Burlington, Mar. 12.

The Iowa Engineering Society was addressed by Edmund T. Perkins, president of the National Drainage Congress, on "Government Land Reclamation," at the 31st annual meeting held at Muscatine, Feb. 19-20. Clifford Older, chief highway engineer, Division of Highways, Illinois, read a paper entitled "The Story of the Illinois $60,000,000 Bond Issue Campaign." The afternoon of the first day of the meeting was devoted to the sessions of the sections on drainage engineering, highway engineering and municipal engineering. The subject of standard fees was discussed.

The Dallas Chapter of the American Association of Engineers elected the following officers at the recent annual meeting: President, A. A. Matthews; vice-presidents, Hart Vance and A. P. Denton; secretary, S. J. Treadway.

The Rochester Engineering Society was addressed Feb. 10 by Lieut. Roger D. DeWolf, U. S. N. R. F., U. S. S. "Nevada," who spoke on "Experiences with the Grand Fleet." At the meeting Feb. 14 William H. Earle, assistant superintendent of gas manufacture, Rochester Railway & Light Co., spoke on "Modern Methods of Gas Manufacture."

The Montana Institute of Municipal Engineers held its annual meeting at Helena, Jan. 20-22. Reconstruction problems constituted the general topic. The following officers were elected for the coming year: President, John D. McLeod, Helena; vice-president, Willis H. Ellis, Butte; director, Carl C. Wideer, Bozeman; secretary-treasurer, Arthur E. Lamb, Helena. The annual meeting of the society for 1920 will be held in Butte.

The Yakima (Wash.) Engineers' Club elected the following officers at the recent annual meeting: President, T. A. Noble; vice-president, J. O. Greenway; secretary-treasurer, A. L. Strong.

The Engineers' Club of Trenton held a meeting Feb. 13 which was addressed by William H. Burr, who spoke on "Important Features in the Development of Concrete Work."

The Engineers' Club of Philadelphia will conduct an excursion to the Ordnance Proving Grounds, Aberdeen, Md., Feb. 20, for the purpose of inspecting various pieces of ordnance used in the war. Dr. Edward Chiera, University of Pennsylvania, will speak on "The Problem of the Adriatic," at the weekly luncheon of the club on Feb. 25.

The Engineers' Club of Boston elected the following officers at the annual meeting held Feb. 10: President, Charles T. Main; vice-presidents, Charles L. Edgar and Charles L. Gagnebin; secretary, L. S. Cowles; treasurer, Frederic H. Fay.

The Montreal Branch of the Engineering Institute of Canada held a meeting Feb. 20, at which J. L. Busfield spoke on "The Construction of the Canadian Northern Railway Tunnel at Montreal." At the meeting Feb. 27 R. M. Wilson will speak on "The Effect of Ice on Hydro-Electric Plants."

The Louisiana Engineering Society was addressed by Maj. A. M. Shaw on "The Construction Division of the Army," at the meeting held Feb. 10.

PERSONAL NOTES

GEORGE J. RAY, chief engineer of the Delaware, Lackawanna & Western R.R., is now acting as engineering assistant to A. H. Smith, regional director of railways under the United States Railway Administration, with headquarters in New York City. L. L. Tallyn, division engineer at Scranton, is acting as chief engineer during Mr. Ray's absence.

MAJ. B. J. LAMBERT, Engineers, U. S. A., has received his discharge from the service and has returned to the professorship of structural engineering at the State University of

Iowa. He was commanding officer of the 3rd Battalion, 23rd Engineers (Highway) from December, 1917, to September, 1918, after which he served as bridge engineer for the First Army.

COL. JAMES P. JERVEY, Engineers, U. S. A., who recently returned from active service with the 79th Division, has been appointed United States engineer at Wilmington, Del.

DAVID A. HARTWELL, recently engaged on work at Newport News, Va., for the United States Housing Corporation and the Emergency Fleet Corporation, has been appointed commissioner of public works and city engineer of Fitchburg, Mass., Mr. Hartwell previously served the city as assistant city engineer for three years; for twenty years as city engineer, and for seven years as chief engineer and superintendent of the sewage disposal division.

MAJ. H. AUSTILL, 20th Engineers, who recently returned to this country, has received his discharge from the service and has returned to his former position as bridge engineer, Mobile & Ohio R.R., at Mobile, Ala.

LIEUT. L. C. DODGE, Engineers, U. S. A., Office of Director General of Military Railways, Washington, D. C., has been discharged from the service and entered the bridge department of the Baltimore & Ohio R.R., with headquarters at Cincinnati.

EDWARD S. WALSH, Brooklyn, N. Y., has been appointed deputy superintendent of public works of New York State under Lewis Nixon, who was appointed superintendent of public works, as mentioned in *Engineering News-Record* of Jan. 16, p. 166.

COL. C. H. MITCHELL, Intelligence Department, British Army, has been appointed dean of the faculty of applied science and engineering, University of Toronto, succeeding W. H. Ellis, resigned.

CAPT. E. L. STAPLETON, Gas Defense Division, Chemical Warfare Service, United States Army, has received his discharge and has become associated with Willard C. Brinton, consulting engineer, New York City.

CHARLES E. KIMBALL, who for a number of years served as manager of the machinery department, Harris Bros., Chicago, has been appointed to a similar position with the American House Wrecking Co., Chicago.

GEORGE L. NASON, Engineers, U. S. A., has received his discharge from the service and has returned to his office in the Endicott Building, St. Paul, Minn., to resume the practice of landscape architecture and engineering.

CAPT. STEUART PURCELL, Quartermaster Department, U. S. A., has been appointed division engineer in charge of highways under G. F. Weighardt, city highways engineer of Baltimore.

CHARLES W. WHITTLE has been appointed assistant engineer, alley and footway division, highway engineer's department, of Baltimore.

J. L. CUMMINGS, acting bridge engineer, Mobile & Ohio R.R., Mobile, Ala., has been appointed division engineer of the Mobile division, with headquarters at Meridian, Miss.

S. W. CHILES, contracting engineer, Bethlehem, Penn., has gone to Santo Domingo to become resident engineer of construction work under A. J. Collett, director general of public works under the United States Military Government.

EDWARD A. LAMBERT, recently construction engineer for the Procter & Gamble Co., Cincinnati, has joined the staff of Fletcher-Thompson, Inc., industrial engineers, Bridgeport, Conn.

LIEUT WALTER L. LEWIS, 136th Artillery, who recently returned from France, has received his discharge from the service and has resumed his work in the engineering department of the Great Northern Railway.

W. C. FAWCETT and KARL L. ROTHERMUND, Wheeling, W. Va., have become associated under the firm name of Fawcett & Rothermund, consulting engineers.

S. F. RYAN has been appointed division engineer, St. Louis division, Mobile & Ohio R.R., with headquarters at Murphysboro, Ill.

EARLE J. HEWIT, formerly with the Illinois State Highway Department, has become assistant engineer in the Department of Highways, State of Tennessee.

A. F. BROWNLEY has been appointed assistant engineer, sewerage division, highway engineer's department of Baltimore.

OBITUARY

LIEUT. COL. HIRAM J. SLIFER, 21st Engineers (Light Railway), died in France Feb. 3. He was born in 1857 and was a graduate of the Polytechnic College of Pennsylvania. He had been engaged in railroad work since 1880, when he became assistant engineer in the construction of the Mexican National Ry., and was later engaged in construction and maintenance work with the Pennsylvania R.R. and the Chicago & Northwestern Ry. as division engineer until 1898, when he became division superintendent for the Chicago & Northwestern, and afterward general superintendent, Central division, Chicago, Rock Island & Pacific Ry. From 1905 to 1907 he was engaged in special work as steam-railway expert for the J. G. White Co., of New York. In 1907 he went to Panama as assistant to the president of the Panama R.R., remaining there until he joined the Chicago Great Western as general manager in 1909, resigning two years later to engage in private practice.

MAJ. C. S. NOBLE, veteran of the Spanish-American War, and lately with the Y. M. C. A., died recently in Tours, France. For a number of years he was engineer for Oregon City, Ore., later becoming associated with the State Highway Commission. He resigned from the highway commission to go to France last autumn.

OSCAR MOORE LANCE, who for 23 years was general manager, Spring Brook Water Supply Co., Wilkes-Barre, Penn., died recently at Kingston, Penn. He was graduated from Lehigh University in 1872, and was for many years superintendent of the three public utility companies of Plymouth, Penn. He became general manager of the Spring Brook Water Supply Co. in 1896, at the time of its formation.

DANIEL B. BANKS, consulting engineer, Baltimore, who had charge of the planning and construction of the high-pressure fire-service system of that city, died Feb. 7. He was born in 1864 and received his education at Princeton University. His first engineering experience was as a rodman on the Shenandoah Valley R.R. and with the Baltimore & Ohio R.R. In recent years he specialized in water-supply work.

E. H. JACOBS, construction engineer and superintendent of distribution lines, Western States Gas & Electric Co., Stockton, Cal., died in that city recently. He went to Stockton seven years ago to undertake the laying of the new underground conduit system, having previously been engaged in work in San Diego under H. M. Byllesby & Co., with whom he had been associated in Chicago.

LUTHER P. FRIESTEDT, president of L. P. Friestedt Co., contractors, Chicago, and of the Friestedt Underpinning Co., New York, died at Los Angeles Feb. 5, at the age of 57. He was engaged in the construction business during all of his working life. He was the inventor of the form of steel sheet-piling known by his name.

Material-Handling Machinery Association

Manufacturers Form Organization — Port and Terminal Problems to Receive Particular Attention

Notices have appeared in this journal of the steps being taken to form an association of manufacturers of material-handling machinery. The preliminary organization work has now been completed, a committee on membership is engaged in recruiting the charter membership, a secretary-manager has been selected and has entered upon his duties, and a preliminary plan has been outlined for the work of the association.

RESULT OF WAR TAUGHT LESSONS

The impetus to form the Material-Handling Machinery Manufacturers' Association, the name of the new body, came in part from the lesson which the war taught as to the benefits to the country and to the manufacturers from mobilization in a strong trade association, and in part from suggestions made by the Department of Commerce and the Shipping Board. These two Government agencies, realizing the need for more efficient operation of railway terminals and ports, urged the manufacturers to get together in order that they might the more efficiently attack these difficult problems, and that the Government in its studies might have available in get-at-able form the combined talent of the handling-machinery industry.

In general, the lines of work—technical, educational, promotional, etc.—will parallel those of other trade associations, but the nature of the problems will require more extensive technical committee work than is customary in such bodies. In one particular the proposed work presents an unusual phase. Since material-handling problems are found in every industry, relations will be cultivated with existing trade associations. These organizations will be asked to appoint committees on material handling which will meet with corresponding committees of the Material-Handling Machinery Manufacturers' Association. Thus the material-handling problems of the various industries will come before broadly representative committees of material-handling experts. Already several of these coöperating committees have been arranged for.

OFFICERS AND MEMBERS

The active conduct of the association's work will be in the hands, as secretary and manager, of Zenas W. Carter, formerly commissioner of the Associated Metal Lath Manufacturers, and previously field secretary of the Granite Paving Block Manufacturers' Association. The officers of the association are: President, Calvin Tomkins, formerly commissioner of docks, New York City; vice-president, J. A. Shepard; treasurer, Lucian C. Brown; directors, Mr. Shepard, Mr. Brown, R. W. Scott, F. W. Hall, William Clark, J. C. Walter, C. M. Watson and Fred Stadelman. Four additional directors are to be chosen when the charter membership is completed.

The following companies have come together in the work of forming the organization and are now constituting themselves a membership committee to complete the charter membership of the association:

The Watson Elevator Co., Edward F. Terry Mfg. Co., the International Conveyor Corporation, Rownson, Drew & Clydesdale, Inc., New Jersey Foundry & Machine Co., Hayward Co., Elwell-Parker Electric Co., Sprague Electric Works, Otis Elevator Co., Manning, Maxwell & Moore, Inc.; Robins Conveying Belt Co., Michener Stowage Co., New York City; Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.; Brown Portable Conveying Machinery Co., Chicago, Ill.; Karry-Lode Industrial Truck Co., Long Island City, N. Y.; Whiting Foundry Equipment Co., Harvey, Ill.; Wellman-Seaver-Morgan Co., Cleveland, Ohio; Alliance Machine Co., Alliance, Ohio; Alfred Box & Co., Inc., Philadelphia, Penn.; Meade-Morrson Mfg. Co., East Boston, Mass.; Alvey-Ferguson Co., Cincinnati, Ohio; Heyl & Patterson, Inc., Pittsburgh, Penn.; American Hoist & Derrick Co., St. Paul, Minn.; Cleveland Crane & Engineering Co., Wickliffe, Ohio; Clyde Iron Works, Duluth, Minn.; Ohio Locomotive Crane Co., Bucyrus, Ohio; Northern Engineering Co., Detroit, Mich.; Electric Controller & Mfg. Co., Cleveland, Ohio.

Offices have been opened at 35 West 39th St., New York City.

Head of War Labor Policies Board Resigns

The chairman of the War Labor Policies Board, Felix Frankfurter, has tendered his resignation to the Secretary of Labor. The board will go out of existence in a few weeks, its activities having come to an end with the close of the war. The executive officer of the board, George L. Bell, will go to New York to become the impartial chairman of a permanent board of arbitration to be organized to handle labor disputes. Mr. Frankfurter was formerly a professor in the Harvard Law School. He has not announced his future plans.

American and Italian Engineers to Promote Public Works

An association has recently been formed known as the "Societa Itala-Americana di Studi i Lavori Publici," in which American engineers and business men are joining with Italian engineers and bankers to study and promote public works in Italy. The society was incorporated in Rome by interests representing the American International Corporation of New York and the Banca Italiana di Sconto of Italy.

The president is Senator Guglielmo Marconi, the inventor of the wireless telegraph, and the directors are the Marquis de Solari, Sig. Angelo Pogliani (managing director of the Banca di Sconto) Maj. James F. Case, H. Nelson Gay and F. Lavis.

The objects of the new company are the study of opportunities for the cooperation of American and Italian interests in the promotion of trade, and the prosecution of public works and other projects of an engineering and construction nature. The movement represents a step toward a better understanding and coöperation between the two countries.

BUSINESS NOTES

The Victor L. Phillips Co., of Kansas City, has taken over the complete line of "Rex" mixers and pavers for the eastern half of Missouri and also the entire states of Kansas and Oklahoma.

Westinghouse Church Kerr & Co., engineers and constructors, 37 Wall St., New York, announce that they have opened an office in the Western Indemnity Bldg., Dallas, Tex., in charge of A. W. Nichols.

The Epping-Carpenter Pump Co., of Pittsburgh, Penn., announces that Theodore R. Hermanson, formerly with the Harrison works of the Worthington Machinery Corporation, has been appointed works manager.

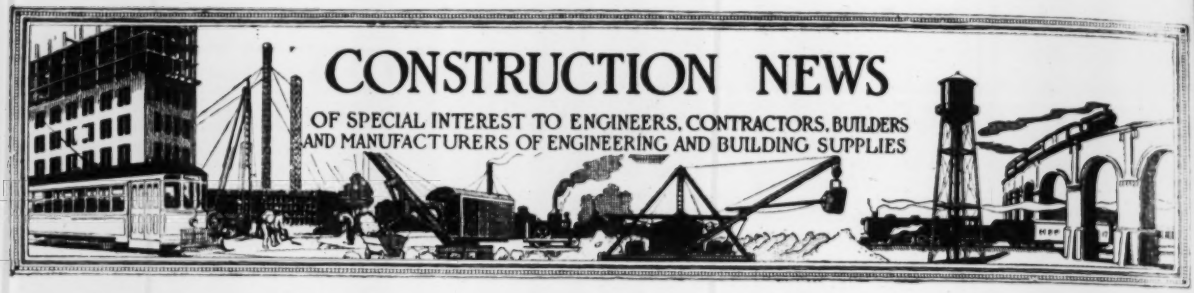
TRADE PUBLICATIONS

The Oshkosh Mfg. Co. of Oshkosh, Wis., announces that its 1919 catalogue of contractors' equipment is ready for distribution.

The Independent Pneumatic Tool Co., of Chicago, Ill., has issued a folder describing the Thor Universal Electric Drill. Specifications and illustrations are given for nine different types of machine.

The Lakewood Engineering Co., of Cleveland, Ohio, has issued bulletin No. 25, entitled "Flat-Wheel Haulage Systems." It is an 8½ x 11-in. 23-p. pamphlet illustrating and describing the company's storage battery trucks and the Lakewood trailers for industrial hauling.

The Westinghouse Air Brake Co., of Pittsburgh, Penn., has recently established a house organ known as "Wabco News." It is an 8 x 11-in. 22-p. magazine issued monthly, and is known as the official journal of the employees of the Westinghouse Air Brake Co., and associated interests.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

For Proposals Advertised See Pages 65-69 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Feb. 25	East Chicago, Ind. Adv. Jan. 30.	Jan. 30
Feb. 28	Clarksburg, W. Va. Adv. Jan. 30.	Jan. 30
Feb. 28	Akron, O. Adv. Feb. 13 and 20.	Feb. 20
Mar. 7	Pembroke, Ont.	Feb. 6
Mar. 18	Wyandotte, Mich.	Feb. 20
Mar. 25	Jersey City, N. J.	Feb. 20

SEWERS

Feb. 25	Columbus, O.	Feb. 13
Feb. 25	St. Louis, Mo.	Jan. 30
Feb. 27	Detroit, Mich.	Feb. 20
Feb. 27	Seal Beach, Cal.	Feb. 20

BRIDGES

Feb. 24	Eureka, Cal.	Feb. 20
Feb. 25	**Sneedville, Tenn.**	Feb. 13
Feb. 25	Grand Forks, N. D.	Feb. 20
Feb. 28	Thomaston, Conn.	Feb. 20
Feb. 28	New Canaan, Conn.	Feb. 20
Mar. 3	Bisbee, Ariz.	Feb. 6
Mar. 4	Lewisburg, W. Va. Adv. Feb. 13 and 20.	Feb. 20
Mar. 5	Holdenville, Okla.	Feb. 20
Mar. 23	**Buckhannon, W. Va.**	Feb. 13
Apr. 16	Ottawa, Ont.	Feb. 20

STREETS AND ROADS

Feb. 24	Middlebourne, W. Va. Adv. Jan. 23 to Feb. 20.	Jan. 30
Feb. 24	San Diego, Cal.	Feb. 20
Feb. 24	California	Feb. 20
Feb. 24	Fairmont, Minn.	Feb. 20
Feb. 24	Dallas, Tex.	Feb. 20
Feb. 25	Abilene, Tex.	Feb. 20
Feb. 25	Baltimore, Md.	Feb. 20
Feb. 25	Ft. Dodge, Ia.	Feb. 20
Feb. 25	New York, N. Y.	Feb. 20
Feb. 26	Ohio	Feb. 20
Feb. 26	Indianapolis, Ind.	Feb. 20
Feb. 28	Harrisburg, Ark.	Feb. 20
Feb. 28	Connecticut	Feb. 20
Feb. 28	Starkville, Miss.	Feb. 20
Feb. 28	Cornwall, Ont.	Feb. 20
Mar. 1	Shreveport, La.	Feb. 13
Mar. 3	Indianapolis, Ind.	Feb. 6
Mar. 3	**Marshall, Minn.**	**Feb. 13**
Mar. 3	Cathlamet, Wash.	Feb. 20
Mar. 3	Portsmouth, Va.	Feb. 20
Mar. 3	Charleston, Miss.	Feb. 20
Mar. 4	De Kalb, Miss.	Feb. 20
Mar. 4	Augusta, Ga. Adv. Feb. 13 and 20.	Feb. 20
Mar. 4	Ripley, W. Va.	Jan. 23
Mar. 4	Indianapolis, Ind.	Feb. 6
Mar. 5	Alexandria, Minn.	Feb. 6
Mar. 5	San Diego, Cal.	Feb. 20
Mar. 6	Fairmont, W. Va. Adv. Jan. 30 to Feb. 20.	Feb. 6
Mar. 7	Eldorado, Ill. **Adv. Feb. 13 and 20.**	Feb. 20
Mar. 10	New Iberia, La.	Feb. 20
Mar. 18	St. Louis, Mo.	Feb. 20
Mar. 31	Lockport, N. Y.	Feb. 6
Apr. 7	Moulton, Ala.	Feb. 20

EXCAVATION AND DREDGING

Feb. 24	Fairmont, Minn.	Feb. 20
Feb. 28	Windom, Minn.	Feb. 20
Mar. 4	Garner, Ia.	Feb. 20
Mar. 11	Rochester, N. Y. Adv. Feb. 13 and 20.	Feb. 20
Mar. 13	Tyler, Minn.	Feb. 6
Mar. 19	Carthage, Ill.	Feb. 20
Mar. 19	Quincy, Ill.	Feb. 20
Apr. 8	Hollandale, Miss.	Feb. 13

INDUSTRIAL WORKS

Feb. 24	Brooklyn, N. Y.	Feb. 20
Feb. 24	Woodhaven, N. Y.	Feb. 20
Feb. 25	New York, N. Y.	Jan. 30
Mar. 4	Thiells, N. Y.	Jan. 16
Apr. 1	Sioux City, Ia.	Jan. 16
Mar. 5	Baltimore, Md.	Feb. 20
Mar. 19	Brooklyn, N. Y.	Feb. 20
Mar. 20	La Crosse, Wis.	Feb. 20

BUILDINGS

Feb. 21	Phillipsburg, O.	Jan. 30
Feb. 24	Norwood, O.	Jan. 23
Feb. 24	Cincinnati, O.	Jan. 30
Feb. 24	Cleveland, O.	Feb. 13
Feb. 24	Far Rockaway, N. Y.	Feb. 20
Feb. 25	St. Louis, Mo.	Feb. 13
Feb. 28	Brooklyn, N. Y.	Feb. 20
Feb. 29	Brooklyn, N. Y.	Feb. 20
Mar. 1	Cloquet, Minn.	Jan. 30
Mar. 1	Cloquet, Minn.	Feb. 13
Mar. 1	Mountain Iron, Minn.	Jan. 30
Mar. 1	Duluth, Minn.	Jan. 23
Mar. 1	Duluth, Minn.	Feb. 6
Mar. 1	Firebaugh, Cal.	Feb. 20
Mar. 3	Rockport, Ill.	Jan. 23
Mar. 3	Brooklyn, N. Y.	Feb. 20
Mar. 4	Utica, N. Y.	Feb. 13
Mar. 4	Wards Island, N. Y.	Feb. 13
Mar. 4	Winnipeg, Man.	Feb. 20
Mar. 15	Culver, Ind.	Dec. 26
Mar. 15	Duluth, Minn.	Feb. 13
Mar. 14	Humboldt, Ariz.	Feb. 20
Mar. 14	Dallas, Tex.	Feb. 20
Mar. 17	Johnstown, Pa.	Feb. 20
Mar. 18	Esquimalt, B. C.	Feb. 20
Apr. 2	New York, N. Y.	Jan. 23
Apr. 10	Newaygo, Mich.	Feb. 6
Apr. 15	Newark, N. J.	Feb. 6

FEDERAL GOVERNMENT WORK

Feb. 24	Addition to Dispensary—Spec. 3780—Rockaway, N. Y.	Feb. 6
Feb. 24	Piping and Equipment—Spec. 3759—New York, N. Y.	Feb. 6
Feb. 24	Dredging—Spec. 3774—Chatham, Mass.	Feb. 6
Feb. 24	Wells and Pumps—Spec. 3577—North Ft. Worth, Tex.	Feb. 6
Feb. 24	Fuel Oil Storage Plant—Spec. 3631—Mare Island (Vallejo P. O.) Cal.	Jan. 30
Feb. 24	Grand Stand and Bleachers—Spec. 3795—Hampton Roads, Va.	Feb. 20
Feb. 24	Cooling Pond—Spec. 3700—North Ft. Worth, Tex.	Feb. 20
Feb. 24	Dredging—Spec. 3579—Ft. Lafayette, N. Y.	Feb. 20
Feb. 25	Jetty Work—Sabine Pass, Tex. Adv. Jan. 30 to Feb. 20.	Jan. 23
Feb. 27	Plumbing — Martinsburg, W. Va.	Feb. 20
Mar. 1	Foundation and Rip Rap—Baltimore, Md. Adv. Jan. 16.	Jan. 16
Mar. 1	Dredging—Superior, Wis.	Jan. 16
Mar. 3	Barracks — Spec. 3728 — Fire Island, N. Y.	Jan. 30
Mar. 3	Barracks—Spec. 3733—San Diego, Cal.	Feb. 13
Mar. 3	Hospital—Baltimore, Md.	Feb. 13
Mar. 3	Post Office—Walden, N. Y.	Feb. 6
Mar. 3	Sidewalks—Washington, D. C.	Feb. 20
Mar. 7	Lavatory Annexes — Shiprock, N. M.	Feb. 13
Mar. 7	School and Assembly—Hall—Wahpeton, N. D.	Feb. 13
Mar. 10	Argon Production Plant—Spec. 3800—North Ft. Worth, Tex.	Feb. 20
Mar. 10	Structural Shop—Spec. 3691—Mare Island, Cal.	Feb. 20
Mar. 10	Railroad Extension—Spec. 3727—Ft. Mifflin, Pa.	Feb. 13
Mar. 10	School and Assembly Hall—Rapid City, S. D.	Feb. 20
Mar. 11	Dredging — Philadelphia, Pa. Adv. Feb. 6 and 13	Feb. 13
Mar. 12	Enlarging Levees — St. Louis, Mo. Adv. Feb. 13 and 20.	Feb. 20
Mar. 12	Boathouse, etc.—Charlotte, N. Y. Adv. Feb. 13 and 20.	Feb. 20
Mar. 19	Post Office, etc., Woodward, Okla.	Feb. 20

MISCELLANEOUS

Feb. 25	Flooring—Willard, N. Y. Adv. Feb. 13 and 20.	Feb. 20
Feb. 26	Repairing Fenders — Newark, N. J.	Feb. 20
Feb. 26	Rebuilding Ferry Racks—New York, N. Y.	Feb. 20
Feb. 26	Distributing System—South Boston (Boston P. O.), Mass. Adv. Feb. 13 and 20.	Feb. 20
Feb. 26	Paving Materials—Detroit, Mich.	Feb. 20
Mar. 1	Bridge Material—Chariton, Iowa	Feb. 20
Mar. 1	Piles, etc.—Blythe, Cal.	Feb. 20
Mar. 3	Dock—Seattle, Wash.	Feb. 20
Mar. 3	Miscellaneous Supplies — Hamilton, Ont. Adv. Feb. 13 and 20.	Feb. 20
Mar. 4	Road Material — Newark, N. J.	Feb. 20
Mar. 3	Riprap—Shakopee, Minn.	Feb. 20
Mar. 5	Road Oil and Tar—Clayton (St. Louis P. O.), Mo.	Feb. 20

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

N. Y., Oswego—City voted $150,000 to be added to existing appropriation of $345,000 to develop water power. W. A. McCaffrey, supt. water-works.

N. J., Newark—City sold $500,000 bonds for water supply system in Wanaque River watershed and $300,000 bonds for extending water supply system in Pequannock River watershed. M. R. Sherrard, city engr. Noted Jan. 30.

Pa., Blairsville—See "Buildings."

Pa., Mt. Holly Springs—Holly Clay Co. having plans prepared building water supply system. About $20,000. Gannett, Seelye & Fleming, 204 Locust St., Harrisburg, engrs.